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CONCRETE PAVING FOR STREETS.

A new system of concrete paving for streets has been introduced extensively in several cities during the past few years, and appears likely to enter into close competition with other types of street paving.

The new system referred to is the invention of Mr. Rudolph S. Blome, of the Rudolph S. Blome Co., street paving and general concrete contractors, of Chicago. Patents were issued to him in June, 1907, covering a number of different combinations of concrete or cement surfacing for street pavements. The construction may be best described by the following extracts from the specifications prepared by the company:

FOUNDATION.—The ground shall be brought to a level 11 ins. below the final level of pavement, and then there shall be placed a layer of coarse sand 4 ins. in thickness. This filling is to be rolled to a true surface, so that the granitoid concrete block pavement will be of uniform thickness throughout. The contractor must use all necessary precaution in preparing the subgrade, so as to support the pavement permanently, and so that the pavement shall remain at the original grade for a period of five years. This clause will not be waived on account of any trenches or holes made in the street prior to the laying of the pavement by any corporation or private party.

All the slopes which shall be given to the street pavement shall be made in the foundation, so that the concrete work will be of uniform thickness throughout. The foundation shall be carefully compacted either by a steam roller or at the discretion of the engineer. Then the concrete shall be put in place, in the manner specified.

MATERIALS.—Cement.—Portland cement shall be used and, ordinarily, will be subjected to the following inspection and tests:

Fineness—It shall be so ground that 92% will pass through a standard No. 100 sieve, having 10,000 meshes per sq. in.

Soundness.—It shall meet the requirements of the "boiling" test.

Setting.—The cement when mixed with 20% of water, by measure, shall take initial set in not less than 45 mins.

Strength.—Briquettes, 1 in. square in section, shall develop the following tensile strength: Neat (1 day in

GRANITOID CONCRETE STREET PAVING AT CALUMET, MICH.
Rudolph S. Blome, Chicago, Inventor.

air and 6 days in water), 400 lbs. A mixture of 1 cement to 3 sand (1 day in air and 6 days in water), 175 lbs.; it shall show a gradual increase in strength of 15% at the end of 28 days.

Sand.—All sand shall be clean, dry, free from dust, loam and dirt; of sizes ranging from ⅛-in. down to the finest and in such proportion that the voids as determined by saturation shall not exceed 33% of the entire volume. It shall weigh not less than 95 lbs. per cu. ft. No wind drifted sand shall be used.

Stone.—All crushed stone used in making the concrete shall be of the best quality of limestone or trap rock; clean, free from dirt, broken so as to measure not more than 1½ ins. and not less than ¼-in. in any dimension. The stone when delivered on the street shall be deposited on flooring and kept clean until used.

MIXING AND LAYING CONCRETE.—The pavements shall consist of 5¼ ins. of concrete base, and surface blocking 1¾ ins. thick, making a total of 7 ins. exclusive of foundation.

After the sub-grade and foundation have been prepared as specified, there shall be deposited concrete composed of 1 part Portland cement, 3 parts sand, and 4 parts crushed stone. These materials to comply with the requirements above noted, and shall be mixed by a machine suitable for the purpose, to be approved by the engineer. It shall be mixed at least six times before being removed from the mixer. The concrete shall be thoroughly tamped in place, and shall be 5¼ ins. thick at all points after having been compacted. It shall be laid in sections, with expansion joints (all as per the Blome company's patents), and shall follow the slopes of the finished pavement so that the surface blocking shall be uniformly of the same thickness at all points.

SURFACING.—After the concrete base has been placed, and before it has begun to set, there shall be immediately deposited thereon the granitoid blocking, which shall be 1¾ ins. thick. It will contain 1 part of Portland cement and 1½ parts of clean, monument, crushed granite. This granite shall be screened, with all dust removed therefrom, utilizing the following composition of this material; 50% of the granite to be of what is known as ¼-in. size, 30% of the ⅛-in. size, 20% of the 1/16-in. size. This proportion of sizes is essential, and must be kept absolutely accurate, as in this lies one of the essential requirements to produce proper results. This material to be mixed with the cement thoroughly, and after being wetted to a proper consistency and deposited on the concrete, shall be worked into brick shapes approximately 4½ × 9 ins. with rectangular surface, similar to paving blocks. This will be done by special methods, and utilizing grooving apparatus as employed under the Blome company's patents.

EXPANSION JOINTS.—Expansion joints must be provided across the pavement, at distances not exceeding 50 ft. apart. These expansion joints shall extend through the blocking and concrete, and shall be filled with a composition especially prepared for the purpose.

The specifications are modified to suit local conditions and requirements. Where the natural soil is clay or similar heavy material, a 3-in. or 4-in. foundation of sand or gravel is used, but this is not required where sand or gravel form the natural soil. The thickness of the paving (both as to its bottom course and the surface coat) varies according to traffic conditions. While the specifications quoted above call for the use of crushed granite in the surfacing, the patents cover trap rock and all other similar hard materials. The spacing of the expansion joints varies according to the width of the pavement.

The concrete for the bed or lower portion is made wet enough to produce a film of mortar on the top after tamping. The concrete for the surfacing is sufficiently wet to produce a dense mixture and also to provide for the compacting, floating, troweling, grooving and brush finish. The grooving is effected by wooden strips mounted in metal holders, or by special grooving machinery which is being perfected. The surface has a granular or roughened finish, due to the use of the fine crushed stone in the surfacing, so that it is claimed not to become slippery by wear.

A considerable extent of this concrete pavement (aggregating over 500,000 sq. yds.) has been built or is actually under contract at various places. These include the new industrial town of Gary, Ind.; Chicago and Kewanee, Ill.; Hancock, Calumet and Kalamazoo, Mich., and Washington, D. C. In addition to this, the company reports contracts at numerous other cities, ranging from New Brunswick, N. J., and Norristown, Pa., in the east, to New Orleans, La., and Fort Worth, Tex., in the west. At Chicago, the paving has been used not only for streets but for driveways in the stockyards and at the plant of the Western Electric Co. In some cases it carries ordinary light traffic, as on residence streets. In other cases, however, it carries traffic which is heavy as to both density and wheel loads. The company claims that its concrete pavement costs less than pavements made of other materials, and will last very much longer. It is also claimed that where the concrete paving is laid against the rails of electric railways, it is not injured by the car traffic and does not crack or disintegrate.

Fig. 1 shows the Blome granitoid concrete pavement in one of the main business streets at Calumet, Mich. It will be seen that the concrete is laid against the rails of the street railway. Fig. 2 is a view on Broadway at Gary, Ind. Here the central portion of the street is left open temporarily for the construction of the street railway track. Fig. 3 shows cross sections of some of the streets paved in this way at Gary. The streets are crowned to bring the center level with the tops of the concrete curbs. In the combined curb and gutter, the curb is 6 ins. thick and from 5 to 13 ins. high, with a gutter slab 18 ins. wide and 6 ins. thick. The sidewalks are about 5 ins. thick. Mr. A. P. Melton is City Engineer of Gary, and Mr. E. M. Scheflow is Assistant City Engineer.

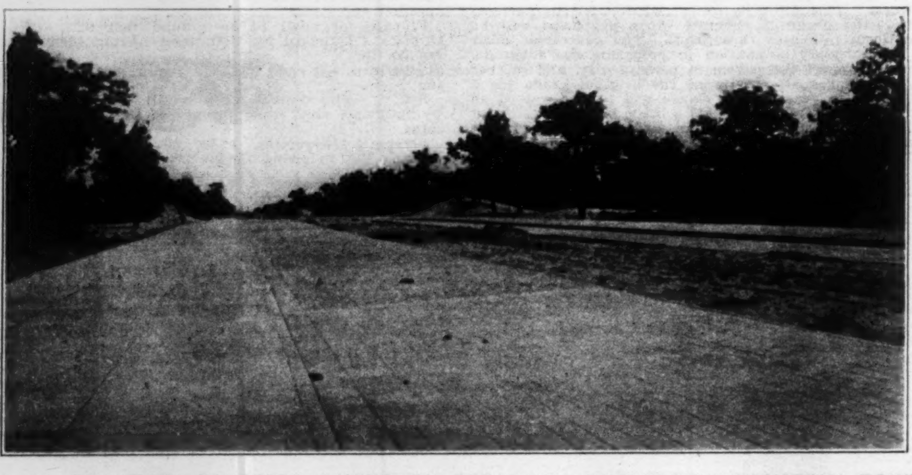

FIG. 2. GRANITOID CONCRETE PAVING ON BROADWAY, AT THE NEW INDUSTRIAL TOWN OF GARY, IND.

(Middle of street left open for street railway.)

CONCRETE PAVING IN VARIOUS CITIES.

As most of our readers know, concrete paving for streets and alleys is not an entire novelty. Many municipal engineers have used it to some extent, following different methods of construction; but its use has not, until the last year or two, been pushed as a commercial proposition.

In an article in our issue of July 21, 1904, Mr. S. Whinery, M. Am. Soc. C. E., suggested a concrete paving composed of a 4-in. foundation (1:3:7) and a 2-in. surface (1:2:4). The two layers would be so built as to form a homogeneous bed of concrete. He estimated the cost of the finished pavement at $1.20 per sq. yd.

Particulars of the construction of and experience with concrete street paving in several cities are given below, much of the information having been furnished to us recently by the engineers.

BELLEFONTAINE, O.—Concrete pavements were laid in 1892 and 1893. After ten years' service, these were in good condition, as described in our issue of Jan. 7, 1904. There were then no cracks of importance and the imprints (made by a roller) to roughen the surface were still visible. The streets had a 4-in. foundation of 1:5 and 1:4 gravel concrete. The [illegible]-in. surface was of cement and coarse sand [illegible] gravel (screened to a ⅜-in. mesh) in proportions of 3:5 or 1:1. The construction cost was about $2.15 per sq. yd.; this included filling, drains and curbs. The repairs have been extremely small, so that the pavements have been very economical.

CHICAGO, ILL.—Mr. John B. Hittell, Chief Engineer of Streets, in the Board of Public Improvements, states that there are now [illegible] sq. yds. of concrete paving. There is a stretch of pavement in front of the Western Electric Co.'s plant on 48th Ave. which is over five years old, but the majority of the paving is from two to three years old. There is heavy traffic at the Western Electric Co.'s plant and on these sections laid in the stock-yards. The stretch on Schlitz Ave., from 113th to 115th Sts., has considerable traffic leading to switch tracks. There is an alleyway paved in the rear of the Palmer House, which would have heavy traffic.

Pavement for ordinary traffic consists of a 5¼-in. concrete base and a 1¾-in. surface coat, the latter grooved into spaces about 4½ × 9 ins. The foundation course is a 1:3:4 mixture, and the surface mixture 1 part of cement to 2 parts of either crushed granite or trap rock, or some other similar hard material.

GRAND RAPIDS, MICH.—Concrete paving was used experimentally in 1901-02. The foundation was 6 ins. thick for the roadway and 3¼ ins. for the sidewalks; this was composed of a 1:3:5 mixture of cement, sand and ¼-in. to 1-in. screened gravel. The top course was 1:2 cement and sand, 1 in. thick for the roadway and ¾-in. for the sidewalks. The pavement was laid in 6-ft. sections, with ¼-in. expansion joints, and was given a coarse brush finish (Engineering News, Nov. 20, 1902).

We are informed by Mr. L. W. Anderson, City Engineer of Grand Rapids, that the city has now 5,606 ft. of streets and alleys paved with concrete. This represents 14,672 sq. yds. The first was laid in 1901. They are all residence streets, so that the traffic is comparatively light. The general practice has been to use a 6-in. foundation of about 1:3:6 concrete, with a 1-in. top course of 1 cement to 2 sand. For the work done in 1907 and 1908, however, a 1½-in. top course has been used, composed of 1 part cement to 2 parts granite chips and dust. The surface is corrugated about every 4 ins. across the street. After troweling, the surface is swept with a wet broom to take off the gloss.

It is found necessary to employ expansion joints, laying the concrete in blocks. Asphalt filling is used for these joints. Failures of the pavement have been largely in the breaking down of the concrete adjacent to the joints, and it is to overcome this difficulty that granite chips and dust are now used in place of sand for the top course. From present experience, and from observation of concrete pavements in other places, it is believed this difficulty will be largely overcome in this way.

The cost of the pavement is estimated to be $1.10 per sq. yd. for sand-mortar top, and $1.25 for the granite-mortar top. There is a guaranty of five years. On some of the streets no repairs were required. On others, it will be necessary for the contractor to replace several blocks or "stones" at the expiration of his guaranty. The city has had no expense for repairs to date.

The specifications for concrete paving on Portsmouth Terrace, in 1908, are given below. They provide for a sand and gravel foundation, 6-in. concrete base, and 1½-in. top course.

SPECIFICATIONS FOR CONCRETE PAVEMENT AT GRAND RAPIDS, MICH.

On the sand and gravel foundation shall be constructed a concrete base 6 ins. thick, composed of 1 part Portland cement (by measure), 3 parts clean, coarse sand, and 5 parts clean screened gravel, broken granite or quartz. No particles of the last shall be more than 1½ ins. in largest dimensions, and the smallest shall be retained upon a sieve with holes ¼-in. square. The size of the particles shall be so proportioned that those passing a sieve of ¾-in. mesh will fill the voids of the portion retained by the same without more than 10% excess.

The cement and sand shall be mixed thoroughly until of a uniform color, after which sufficient water shall be added to make a reasonably stiff mortar. The proper

> proportion of gravel shall then be wet and added, and the same thoroughly mixed until of a uniform consistency. The concrete shall then be deposited in place on the foundation in a quite wet condition and thoroughly tamped into place.
>
> Expansion joints shall be made between the pavement and the coping walls, and blocks made in lengths of 25 ft. of street. Provision shall be made at the longitudinal joint for filling with an asphalt filler of the full depth of the stone.
>
> The concrete shall be struck off by template to a depth of 1½ ins. below the finished surface. Special care shall be taken to keep all large stones back from the edges of the blocks, and to have the concrete of the greatest possible density at that point. Each block shall be made by continuous work, with the placing of the concrete foundation and placing and finishing the topping.
>
> Immediately after laying the foundation, before the same has had a chance to dry or set, the top coating shall be placed. This will consist of 1 part Portland cement and 1½ parts of granite screenings (with such proportions of sand added as the engineer shall consider necessary to thoroughly fill the voids in the screenings). The mixture shall be thoroughly mixed to a uniform color before wetting. It shall then be wet and thoroughly mixed to a uniform consistency which shall be reasonably soft. The top shall be placed and struck level with the forms by means of a template, after which all the surface shall be thoroughly tamped with narrow tamps to remove all air spaces and secure dense edges. The top shall then be floated to a uniform surface and very thoroughly troweled to secure a hard top surface.
>
> The surface of the pavement shall have the east 3 ft. finished without grooves, given a light brush finish on the flatter slopes and a broom finish on the steeper portion. The remainder of the pavement (with the exception of a strip 1 ft. wide in the center) shall be grooved crosswise of the street, with a heavy marker, drawn to a straight edge. This must give a groove about ⅜-in. deep, with edges slightly rounded to prevent their chipping. The edges of all blocks shall be rounded to similar radius with proper tools. After completing the grooving, the surface shall be lightly brushed with a soft brush. The grooving tool shall be of such weight and applied with such pressure as to give a hard compact surface.
>
> The pavement shall be laid in alternate sections of blocks. Wooden templates thoroughly braced in place shall be used at the edges. Expansion joints shall be made by inserting a strip of lumber dressed with a taper and covered with tar paper, permitting of the lumber and paper being withdrawn on completion of the work. The filler shall be Pioneer brand, made by the American Asphaltum & Rubber Co. It shall be heated and poured according to directions furnished by the company, subject to the approval of the engineer. The filler shall be applied with cans suitable for pouring without coating the top of the pavement, and shall not be applied until the concrete is thoroughly dried so as not to be affected by heat.
>
> Immediately on completion of the concrete work, which shall be not to exceed 24 hours after finishing, the surface shall be covered with ½-in. of sand. This shall be thoroughly wet every day for a period of ten days. Any negligence of this provision on the part of the contractor shall empower the city to see to the sanding and sprinkling on the part of the city without further notice.

NEW ORLEANS, LA.—In 1901, concrete paving was laid in the "neutral ground" occupied by street railway tracks on Canal St. This had a 4-in. foundation composed of cement, sand and river gravel, 1:3:7. Under each rail was a longitudinal concrete beam. The 1-in. surface finish was of cement and sand, 1:1. In 1902, the City Engineer reported that this had failed, partly by subsidence of the subgrade and partly due to vibration. In several places the top course was not properly bonded with the foundation and became separated from it. It therefore became fractured and disintegrated. Where a good bond had been obtained and the entire pavement was one homogeneous body, the pavement was in good condition. (Engineering News, Sept. 24, 1903).

RICHMOND, IND.—Concrete paving has been used with success under ordinary heavy traffic, both in streets and alleys. In 1905, there were about 4,300 sq. yds., and some of this had been in service for ten years. This was described in our issues of Jan. 28, 1904, and March 2, 1905. According to the specifications quoted in the latter issue, a bed of concrete 4 to 5 ins. thick was laid upon 3 to 4 ins. of gravel. When the concrete had set, it was covered with fine sand, which was then raked off with a flat board so as to leave it only on the voids and low places. Upon this foundation was placed a layer of tar-paper to form a separating joint. The lower part of the pavement proper consisted of a concrete base 2 to 3 ins. thick, made as a rather wet mixture of 1 cement, 2 sand, 3 gravel and 3 stone. Upon this was the 1-in. wearing surface, composed of 1 part each of cement, sand and clean stone screenings. This surface coat was placed in two layers. A ½-in. layer was first thoroughly tamped to ensure perfect contact with the fresh concrete of the base, and the second layer was laid immediately and troweled. When sufficiently hard, the surface was finished with a steel trowel and a cork float. This gave a smooth surface that did not become glassy by wear or slippery in wet weather.

According to a statement furnished to us recently by Mr. Fred R. Charles, City Civil Engineer, the city has now 8,250 sq. yds. of concrete pavement. The oldest has been in use since 1896, and no repairs have yet been made, although heavy traffic is carried. The surface shows neither wear nor disintegration. The pavement is made 6 ins. thick, and has a 1½-in. wearing surface finished with cork trowels. The cost for alley paving has been as high as 18 and 20 cts. per sq. ft. in the earlier years; in 1907 it ranged from 13¾ cts. to 16 cts. per sq. ft. A report on this style of paving was made in May, 1908, by Mr. Charles, who has furnished us with a copy; this we reprint practically in full:

> Our first concrete pavement was constructed in 1896 in the alley adjacent to the Westcott Hotel. Being a narrow alley, a large traffic was concentrated in a small space. Nevertheless, after 12 years, this pavement shows almost no signs of wear. A slight sinking of gravel around the foundations of the hotel has caused a little settlement of the alley, but this, which would be disastrous with other forms of pavement, has only resulted in a slight unevenness of the blocks, which have not even cracked.

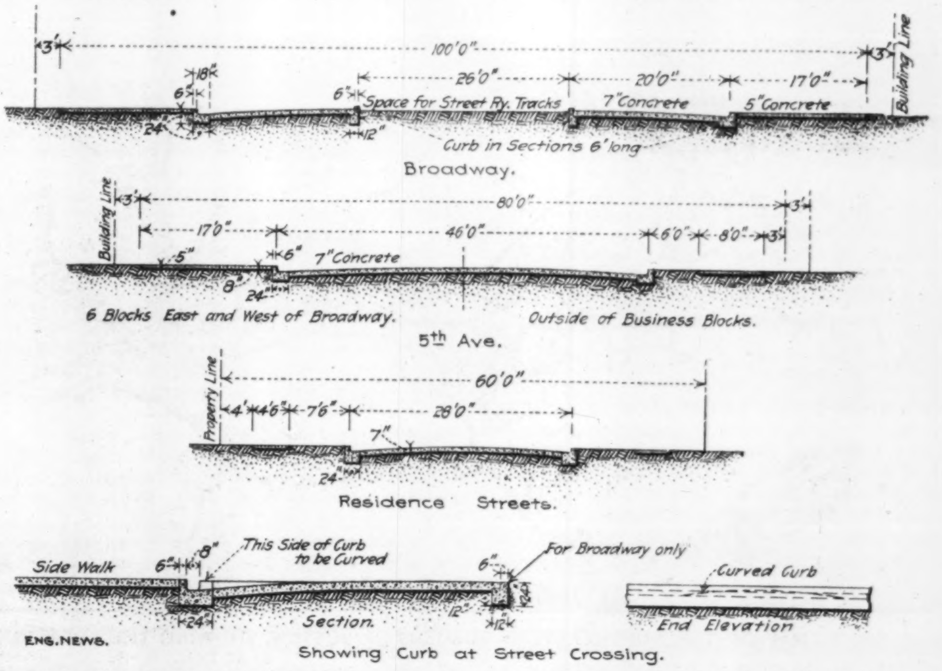

FIG. 3. CROSS-SECTIONS OF STREETS LAID WITH CONCRETE PAVING AT GARY, IND.

> In 1902, Sailor St. was paved with concrete, and now is in almost perfect condition. In 1906, it was necessary to cut a trench the length of this street to lay telephone conduits, and the concrete was found to be so hard that it could only be cut with great difficulty. On completion of the conduit the pavement was very carefully repaired and now seems as good as new. In 1903, concrete was put down at North A and 7th Sts., a very busy intersection of two principal streets. In 1904, it was laid on Elm Place, a street adjacent to the Arlington Hotel and several wholesale establishments, and which carries a great deal of heavy hauling, especially from the hardware and iron storage house of the Jones Hardware Co.
>
> These last two pavements were laid in large blocks with expansion joints 1 in. wide, filled with pitch. These wide joints are a disadvantage, since the edges of the blocks begin to chip a little at these places. With the exception of these places and a few temperature cracks, which cause no serious detriment, the pavements are in excellent condition, and will apparently last for years with no repairs or maintenance charges. On our later work we do not use the wide joint but find the ordinary sand joint satisfactory.
>
> In addition to those mentioned, we are constructing concrete pavements every year, more especially on alleys, which are in the business portion of the city and carry a large traffic in the way of drays, brewery wagons, and other heavy hauling. This travel concentrated in a narrow space, constitutes a more severe test than on streets where it can be more distributed. Our citizens are very well satisfied with this form of pavement. Unlike asphalt and other materials, it is not damaged but is actually benefited by water. Consequently it can be flushed with a hose and is very easily kept clean. This is an important item from an esthetic and sanitary standpoint.
>
> The initial expense is moderate. It costs us about 30% less than vitrified brick. Repairs and maintenance charges apparently will be nothing for a great many years, and the life of this material will doubtless equal or exceed that of brick. It is somewhat slippery for horses; about the same as brick. Many drivers prefer it to brick; others, of course, prefer the latter. Even when wet it is not so slippery as asphalt. It is significant that those who reside on these streets and use them the most, and have the best chance to observe them, are the most enthusiastic in favor of concrete.

KALAMAZOO, MICH.—The City Engineer informs us that the city has 10,000 sq. yds. of concrete pavement, which has been in use one year. The traffic is heavy, but there is no wear or disintegration of the surface. No repairs have been made. The base portion is 4½ ins. thick, with a 2½-in. surface finish. The cost complete was $1.74½ per sq. yd.

HANCOCK, MICH.—Mr. C. B. M. Craig, City Engineer, informs us that the city has 8,000 sq. yds. of the patented "granitoid" concrete paving for streets. This was laid in 1907. The traffic is mixed, the pavement being on the principal (almost only) business street in a town of 8,000 population.. The 5½-in. bottom course is a 1:2½:4 mixture of Portland cement, coarse sand and crushed trap rock. The 2-in. wearing surface is a 1:1½ mixture of cement and sand. The surface is grooved into a blocked surface about 5 × 8 ins., and brush finished after thorough trowelling. It shows some wear, but no repairs have been needed as yet. The cost was $2.29½ per sq. yd. This includes a 6-in. gravel foundation but does not include grading.

KEWANEE, ILL.—Mr. Ellis F. Ingham, City Engineer, informs us that the city has one block (or 845 sq. yds.) of concrete pavement. This has been in service for four years, with medium traffic of both wagons and carriages. The pavement is 6 ins. thick, on a 7-in. cinder base. It was laid with grooves or corrugations in both directions, forming 6-in. squares, the corrugations being about ½-in. deep. The surface shows very little wear, except along the longitudinal corrugations. Mr. Ingham states that this could be avoided in new work by having the corrugations made diagonally, or interrupted (like the broken joints in brick paving). The cost of the pavement complete was $1.54 per sq. yd. This is exclusive of excavation, which cost 27 cts. per cu. yd. No repairs have been made.

DENVER, COLO.—A 6-in. concrete pavement has been used for some time by the city for paving alleys, and by the Denver Tramways Co. for paving between its rails and tracks. In both cases, the lower portion and the surface coat are laid so as to form one solid mass. For the track paving, there is a 3-in. bottom course 1:3:7, and a 3-in. top course 1:2:4.

The City Engineer informs us that there are now 30,000 sq. yds. of concrete pavement in the alleys, the oldest having been in use for three years. The traffic is heavy, including coal wagons. There is no wear or disintegration, and no repairs have been made. The pavement is 6 ins. thick, with a 4-in. bottom course of 1:3:6 concrete, laid on a 3-in. bed of cinders. The 2-in. surface coat is of 1:2:4 concrete, and is finished with a rough float. The cost ranges from $1.08 to $1.27 per sq. yd., including subgrading.

Mr. John Evans, Chief Engineer of the Denver Tramways Co., informs us that the street railway lines have 29,600 sq. yds. of street paved with concrete. This paving is laid only between the outside rails. It was first used in April, 1906. The construction includes a 15-in. bed of stone ballast, a 6-in. concrete base, and a 3-in. concrete wearing surface. The concrete forms a solid mass 9 ins. thick. The surface coat is smooth; it is tamped with shovels and roughened with brooms. The traffic is heavy, but the pavement gives excellent wear and shows no disintegration. The cost of the pavement complete (and constructed in the midst of heavy traffic) is $2.55 per sq. yd.

WASHINGTON, D. C.—We are informed by Capt. E. J. Dent, Corps of Engineers, U. S. A., that on the approaches to the highway bridge across the Potomac River at 14th St., there have been laid for the United States a total of about 14,000 sq. yds. of concrete pavement, under contract with the Rudolph S. Blome Co., of Chicago. The oldest part of this pavement has been in service about two years. A record of the number of vehicles crossing the bridge during seven consecutive days in June of this year shows an average of about 1,200 vehicles a day, exclusive of street cars. A large proportion of these were two-horse teams hauling narrow-tired wagons loaded with brick.

The pavement consists of a 5½-in. layer of 1:3:5 concrete, surmounted by a 1½-in. wearing surface. The latter is composed of 2 parts of cement and 3 parts of crushed granite, screened to pass through a ¼-in. ring and from which the dust has been removed. The surface was finished by sub-dividing it into blocks about 4 × 9 ins.; the grooves between the blocks are about ½-in. deep by ⅜-in. wide, with edges neatly rounded. The longer dimensions of the blocks are perpendicular to the axis of the street. Before the surface became hard, it was slightly roughened by brushing. In one section the surface shows sufficient wear to practically obliterate the marking. In a few places holes are forming where the wearing surface has been entirely cut through, and disintegration has reached the base. Repairs are made by cutting the entire thickness to sub-grade, and replacing the base and wearing surface with new work.

The cost to the United States was about $2 per sq. yd., which included the cost of shaping and rolling the sub-grade and repairs for five years under a guarantee clause.

Capt. Dent states that in subdividing the surface of the pavement into small blocks, the longitudinal grooves were made continuous, and there is a tendency for wagons to follow these grooves and cause longitudinal ruts. None of these ruts are yet serious, but he suggests that it is probable that better results would be obtained by making the longitudinal grooves shallow or omitting them altogether. The pavement is divided into sections about 100 ft. long by 1-in. expansion joints filled with a tar or asphalt compound.

TORONTO, CANADA.—Mr. C. H. Rust, City Engineer, states that the total area of concrete paving laid in Toronto is 7,000 sq. yds. The first of this was laid in 1902. On all but one street the travel has been light, but on this street the traffic was exceedingly heavy and the pavement consequently did not wear as well as was expected, the whole surface being very badly abraded and the joints badly shattered. With the exception of this pavement, however, no repairs have been necessary. The cost this year runs from $1.30 to $1.45 per sq. yd.

The specifications provide for a 4-in. base of 1:2:5 concrete, made with furnace slag, broken stone or screened gravel. This must be free from stones over 2 ins. diameter. The 2-in. wearing surface is laid before the foundation has had time to set, and is a 1:1:3 mixture, made with crushed granite or quartzite. The surface is marked into blocks 8 × 10 ins. In the center of the pavement, and across it at intervals of 20 ft., are expansion joints 1-in. wide. There are filled with pitch.

* * *

AN INVENTORY OF THE NATURAL RESOURCES of the United States is now being carried on jointly by the National Conservation Commission and various executive departments of the United States Government, to be included in a preliminary report of the Commission, which will be published on Jan. 1, 1909. The compilation of the information supplied by the various executive departments of the Government will be carried out under the direction of Mr. Henry Gannett. It is expected that the material will be ready for the first meeting of the Commission, to be held in Washington on Dec. 1.

THE PROPOSED BOSTON & EASTERN ELECTRIC R. R.: AN ACCOUNT OF HEARINGS BEFORE THE MASSACHUSETTS RAILROAD COMMISSION.

By H. S. KNOWLTON.*

There is now pending before the Massachusetts Railroad Commission a petition for a certificate of public convenience and necessity to be granted to the Boston & Eastern Electric R. R. Co., an organization formed for the purpose of building a high-speed electric interurban railroad between Boston, Lynn, Salem, Beverly and Danvers. At frequent intervals for about a year past, hearings have been held by the Board in regard to the details of this project, and a vast amount of testimony has been offered for and against the scheme. Probably no electric railway case ever brought before this Board has received such thorough investigation or shown such complete preparation of technical problems.

The original plans of the company, as prepared by its chief engineer, Mr. John H. Bickford of Boston, contemplated the termination of the line at the Sullivan Square Terminal of the Boston Elevated R. R. Co. in Charlestown, as shown by the dotted line in Fig. 1. After protracted hearings the Railroad Commission decided that the scheme was defective in failing to bring its passengers into the heart of Boston. The Board stated that the territory through which the road desires to pass needs additional facilities, and did not dismiss the company's petition but allowed the problem of the supply of these facilities to remain open. This territory is now served by the Boston & Maine R. R., the Boston, Revere Beach & Lynn R. R., both of these steam lines and by the Boston & Northern Street R. R., a large trolley system operating about 400 miles of track in the northern and eastern sections of Massachusetts and in southern New Hampshire.

After the decision of the Board in September, 1907, to the effect above outlined, the Boston & Eastern Co. prepared a new set of plans with the Boston terminus located in Post Office Square, near the centre of the Boston financial district. With these plans was filed a detailed estimate of the cost of construction, which is appended. The character of the proposed line involves a private right of way through practically the entire route, double track construction for a maximum speed of about 45 mi. per hr., no grade crossings, a tunnel beneath Boston Harbor from East Boston to the city proper, a subway from the water's edge under either Milk or Water St. to Post Office Square, station platforms level with car doors, multiple-unit trains operated by a third rail system using direct current

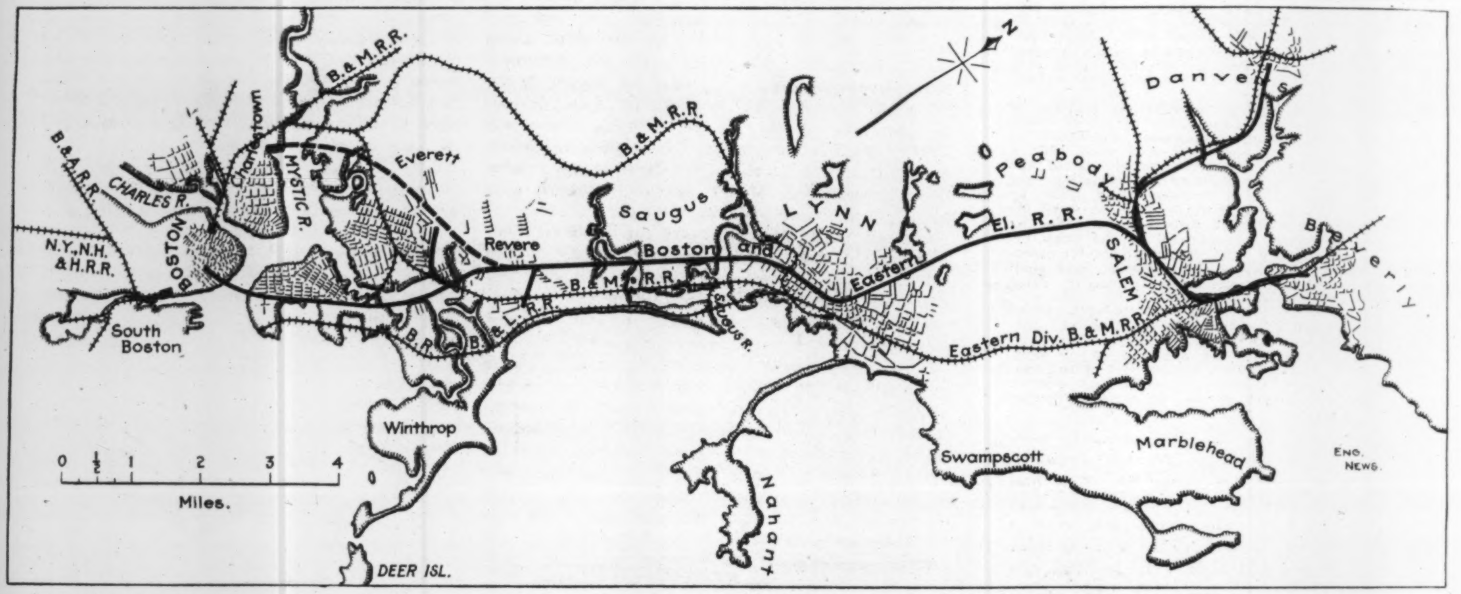

FIG. 1. MAP OF THE NORTHEASTERN SUBURBS OF BOSTON, SHOWING THE LOCATION OF THE PROPOSED BOSTON AND EASTERN ELECTRIC R. R.

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*23 Richardson St., Newton, Mass.

at [illegible] volts, fireproof cars with end and side doors. It is proposed to make the run between Post Office Square and Salem in about 20 minutes.

The opposition has centered in the argument that the present facilities in the territory are adequate for its needs, if developed fully or expanded, and in the attempt on the part of the existing companies to show that the plans are not suitable to meet the situation.

At a recent hearing the counsel for the opposition requested Mr. Bickford to show the differences between the high-speed electric interurban line he desires to build and the existing steam lines if electrified.

What are presumed to be the final series of hearings of this project were begun before the Massachusetts Railroad Commission on May 19 of this year. Chief Engineer Bickford presented an exhaustive discussion of the differences between his proposed road and the Boston & Maine and the Boston, Revere Beach & Lynn steam railroads, if the latter were electrified. The discussion grew out of questions of counsel for the opposition at a previous hearing in regard to the need of additional facilities of the proposed Boston & Eastern character in case the steam roads serving the territory should be electrified.

Mr. Bickford held that no example of an existing electrified steam railroad can be taken as a criterion by which to measure the results which might be realized by changing the motive power on either the Boston & Maine or the Boston, Revere Beach & Lynn roads.

To continue Mr. Bickford's statements, the differences in the fundamental movement of traffic are of primary importance, the electric type of road being limited to the carrying of certain classes of freight and suburban passengers while the Boston & Maine is a through line, conducting five classes of traffic; (1), the suburban passengers; (2), through passengers; (3), express and baggage freight in passenger trains; (4), suburban bulk freight, and (5), through bulk freight.

If the Boston & Maine were to be electrified the service would be no greater in flexibility, and there would be no increased speed over present conditions. Under the conditions prevailing it would mean simply a change in haulage method, and on account of the great complication of the tracks between the Boston terminal and Beverly, it would be necessary to carry all the conductors overhead to insure safety to the trainmen. It would not in this case be feasible to adopt the third rail.

It would be fundamentally impossible, it is claimed, to perform the service proposed on the Boston & Eastern on the existing tracks of the Boston & Maine in this territory and to continue the present freight and through business. Were this attempted four classes of trains drawn by locomotives would be operated on the path of the single-unit motor cars or the multiple-unit trains of the suburban service. These multiple-unit trains to equal the service planned for the Boston & Eastern must run on a uniform fixed headway at frequent intervals and at a much greater average speed than those other trains. That is, there would be on the same tracks the suburban express and accommodation electric passenger service; the long-distance steam passenger service which must stop at least at the cities of Lynn and Salem; steam trains from several branches which must either change their passengers to the multiple-unit trains at Beverly, Peabody and Danvers, or haul them through by locomotives, the latter course being the only practical one for the passenger; the local freight trains which are constantly being shifted across the main tracks to and from the numerous sidings in the territory, and the through freight trains which also exchange large numbers of cars with these sidings en route. The arrangement of these six classes of service in one schedule to accommodate such suburban electric service as is proposed for the Boston & Eastern is, according to Mr. Bickford's argument, dangerous and difficult.

The acceleration adopted for the Boston & Eastern trains is 1.82 mi. per hr. per sec. But one class of trains are planned for the road, and all will accelerate alike. A speed of 55 mi. per hr. will be reached in 60 seconds. The only variation between the local and the express trains will be in the stop intervals, and the zone system of station stops has been planned to eliminate as far as possible the variation in the stops of the different trains. All cars would be of the same class and no electric locomotives are planned for use on the road. At night when the tracks are reasonably clear, locomotive-drawn trains would be permissible to an extent to allow for the growth of a non-interfering freight service. The average acceleration of trains drawn by steam locomotives will vary from 0.25 mi. per hr. per sec. in heavy express trains, to 0.5 mi. per hr. per sec. for the shorter local trains. Tests of acceleration on multiple-unit, motor-car trains have shown that in some cases a run of a full mile from standstill has been attained in the time required for a steam locomotive-drawn train in through express service to attain its full length. This variation of the acceleration, speed and headway of the locomotive-drawn trains would place a limit upon the number and speed of the electric trains and also render their operation extremely dangerous. The varying acceleration, speed, headway and stops, the disadvantage of change of passengers, baggage and express matter at the termini of the electrical zone and the delays consequent upon the distribution of the baggage and express matter from the electric trains in the electric zone render the operation of electric motor cars, according to Mr. Bickford, to give the service proposed by the Boston & Eastern, on the existing tracks of the Boston & Maine between Boston and Beverly hazardous and prohibitive.

The next point discussed was the effect of electrifying two new tracks to be built by the Boston & Maine for purely electric service. Mr. Bickford stated that while the electrifying of the existing tracks and the use of electric locomotives for all trains, or for passenger trains only, is feasible, physically and commercially, only a single material advantage, either to the road or to the public would accrue to warrant such a change. This is the highly desirable elimination of smoke but it is doubtful if the steam railroads entering Boston should be compelled to abate this nuisance at so heavy an expense when no other great advantage would result. If additional tracks are installed, they must be used exclusively for suburban passenger traffic, except at night, when a limited freight service could be handled.

This raises the question of commercial feasibility, due to the reconstruction of the roadbed, elimination of grade crossings, with provision for the shifting of freight to and from the main tracks to the numerous sidings, which of necessity cannot be elevated or depressed, except in simple cases, the policy of incurring a great expense to conduct a traffic which the president of the Boston & Maine says is not profitable and the further policy of allowing such traffic to interfere with the free movement of a profitable long-distance traffic in passengers and freight—the last two kinds of traffic constituting more than 85% of the total business of the road.

It was further claimed that very little advantage exists in using electric over steam locomotives in these conditions. The operation of the unit motor cars or multiple-unit motor-car trains on these additional tracks, constructed especially for the suburban service, will bear the same movement relation to the four other classes of trains, which will run on the other two tracks, whether the existing tracks are or are not electrified.

The impression immediately prevails that not only can the suburban passenger service in the electrified zone be conducted on these additional tracks, but that the branch-line and the long-distance passenger service can be conducted over these two tracks also, leaving two tracks for freight. There would still be three classes of trains of varying acceleration, speed, headway and stops in the path of the electric motor cars. These would limit the capacity and efficiency of the motor-car service and increase the hazard. There are several alternatives. One would be to run the long-distance passenger trains on the existing tracks and the branch-line trains on the electrified tracks, either with steam or electric locomotives. Or, all the locomotive-drawn trains could be handled on the existing tracks. As a third alternative all passengers, express and baggage from branch trains could be changed to the motor trains at Beverly, Peabody or Danvers. These schemes are all of questionable feasibility. Analyzing them, it is found that to run the long-distance passenger trains on the existing tracks is perfectly feasible but to run the branch-line steam trains on the two new electrified tracks still leaves trains of varying characteristics in the path of the motor cars, thereby decreasing the capacity and efficiency of the suburban service. In this case the obstruction caused by the branch-line trains is serious because they consist of both expresses and locals. If all the locomotive-drawn trains are operated on the existing tracks the road would be conducting duplicate suburban services, neither of which would be run at the highest efficiency. The delays of changing passengers, baggage and express at the end of the electric zone would not be tolerated by the public.

Mr. Bickford further claimed that the most serious difficulty in the way of simultaneously conducting these classes of service is the impediment and hazard due to the movement of freight. No matter how the tracks be arranged, the numerous sidings, yards and other special tracks on the Boston & Maine right of way will be in the way of the suburban train service on account of the crossing necessary in the shifting of freight. Whatever is done by the Boston & Maine in this territory, either electric or otherwise, is likely to be outgrown inside of three years. This steam road's legitimate and profitable business is the development of its freight and long-distance passenger traffic, leaving the short haul business to the electric roads. No steam road can afford to allow suburban traffic to choke its terminal lines tributary to a large city where the cost of such privileges has reached into the many millions and where the terminal charge per passenger is equivalent to the full fare for stations within a radius of five miles. The North Station is far from the center of Boston, which is the objective point for the suburban passenger. The Boston & Eastern terminal at Post Office Square would be practically in the heart of the city. The route of the Boston & Maine is two miles longer between Beverly and Boston than the route proposed for the Boston & Eastern and three miles longer to Danvers.

Mr. Bickford estimated that the cost of electrifying the Eastern Division of the Boston & Maine from Boston to Beverly and Danvers would be in excess of $10,000,000, including extra roadbed, tracks, abolition of 26 grade-crossings, the widening of 21 overhead bridges, electrification of the numerous sidings, freight yards, the reconstruction of the Salem tunnel, an expensive change at Lynn, the reconstruction of all stations to accommodate stepless cars, the complete electrification of the four tracks, the building of the power house and all necessary work. The construction of a tunnel for suburban train service on the Boston & Maine between North Station and Post Office Square would add $2,000,000 to the cost of the electrification, besides giving an inferior service. Under such circumstances there would be no possibility of a reduction of the present fares to meet the fares proposed by the Boston & Eastern. In order to be a commercial success, the electrification must increase the volume of business nearly five times, which would be $13.50 per capita per year against the estimate of $6.50 for the Boston & Eastern.

In every electrification scheme, it was maintained, the specific conditions surrounding each road and even each division or branch of a road must be studied and these local conditions will always decide the feasibility of the electrification. What is possible and physically or commercially feasible for New York railroads is not necessarily applicable to the roads of Boston or Chicago or to those of other large cities that radiate from a center and pass through near-by large manufacturing cities and towns. In the New York Central electrification plans the complete separation of the four classes of locomotive-drawn trains from the motor-car trains was necessary. Consequently two additional tracks were added to the four existing tracks.

The Boston, Revere Beach & Lynn road, it was claimed, is in a class by itself, being an "inter-outskirts" road instead of a true interurban line. This road is handicapped by a ferry line and a 3-ft. gage. This gage does not permit the use of motors of sufficient power to handle the necessary service with the required speed and safety. The rails and stations now in use are too light or unsuited to the requirements of electric-train service. The road does not serve the same territory as the proposed line, and the cost of electrification would be too great to pay upon it, including the building of a tunnel under Boston Harbor, and the practical rebuilding of the road as a whole.

At a continued hearing of the Boston & Eastern project before the Commission on June 10, Col. M. O. Adams, President of the Boston, Revere Beach & Lynn R. R., introduced Mr. Geo. M. Tompson, M. Am. Soc. C. E., of Wakefield, Mass.

Mr. Tompson stated that it would not pay the company to electrify its line at present, as the present service is adequate. He read a letter from the Westinghouse Co. stating that it could furnish 50-H. P. narrow-gage motors for the road, of the 600-volt, interpole type, for $3,500 per car, each car having four motors. The present schedule could be maintained with this equipment. The estimated cost of electrifying the road was, according to Mr. Tompson, $1,000,000, with $125,000 more if the change was made to a standard-gage basis. Neither the public nor the company would gain anything by electrification. If the road should be electrified it ought to be extended to Essex County in order to tap a larger territory. It might be deflected from the present course near the Saugus River or extended from the existing terminal at Market Street, Lynn. If the road were electrified a double track tunnel under Boston Harbor at an estimated cost of $3,000,000, or from $250 to $300 per foot would be needed.

Mr. Tompson stated that he had examined the New York Central and New Haven electrifications, and felt that the electrifying of the Boston & Maine would be, for its Eastern Division, a simpler task than the work outside Woodlawn and between that point and Stamford. The Boston & Maine is 18 miles long between Boston & Beverly, and of this 14 miles of the roadbed are wide enough for four tracks, without the purchase of additional land. The sharpest curve is one of 5° near the Mystic River. He figured that the estimated cost of separating the grade crossings and four-tracking the Boston & Maine between Boston and Beverly, including the improvement of the Salem tunnel, would be about $12,000,000.

Under cross-examination by Mr. Ezra Thayer, counsel for the Boston & Eastern, Mr. Tompson stated that his estimate of $1,000,000 for the cost of electrifying the Revere Beach & Lynn R. R. was made up as follows:

Power station	$420,000
Overhead construction	90,000
Bonding	15,000
Motors	350,000
Control	30,000
Brake equipment	40,000
Engineering	30,000
Interest	30,000
Total	$1,005,000

In rebuttal to this testimony, Mr. J. H. Bickford, Engineer for the Boston & Eastern R. R., stated that Mr. Tompson's cost estimates for electrification were too low and, besides not taking account of the larger motors needed in case of electrifying on a standard-gage basis, they did not allow for power plant and repair shop changes and general equipment.

The last hearing on the Boston & Eastern Electric R. R. project was held before the Commission on June 30. Col. Melvin O. Adams, President of the Boston, Revere Beach & Lynn R. R., spoke at length in opposition to the project. He described the additional facilities that this company is prepared to supply. He urged that an established company like this road, doing its business in a proper and progressive manner, should be given a reasonable measure of protection. He claimed that he has the same right as the Boston & Eastern Electric R. R. to plan a tunnel under Boston Harbor and if it should be necessary to extend his road it could readily be done in the direction of Essex County.

Counsel for the Boston & Maine R. R. urged that the facts do not warrant the building of the road. The money it would cost could better be expended on the four-tracking and other improvements of the existing roads in the territory. He claimed that all the traffic in the suburban territory within 15 miles of Boston on the Boston & Maine and other lines would be taken away by the new line if it should be built.

For the Boston & Northern Street R. R. Co., Mr. Bentley W. Warren pointed out the possible influence of a tunnel under the city of Boston between the North and the South stations in case of a future merger of the Boston & Maine and the New Haven systems. He also asked that the work of the Massachusetts Metropolitan Improvement Commission be finished and reported upon before a favorable decision be given by the Board to the Boston & Eastern Co., and claimed that the territory is now served as is no other outside Boston of the same character. He asked the Commission to recommend such improvements as it thinks necessary upon the existing systems of steam and trolley transportation, rather than to allow a construction that would mean four independent lines of transportation within 1.5 miles of each other.

In closing the arguments, counsel for the Boston & Eastern Co. claimed that the opposition had not successfully attacked the detailed studies prepared and submitted to the Board by the engineers of the company, and stated that none of the existing companies in the field had stated any plans that they actually proposed to carry out in bettering the conditions in the territory. The Commission then took the matter under advisement with the expectation of rendering a decision later in the season.

APPENDIX: REVISED ESTIMATE OF CONSTRUCTION COST FOR POST-OFFICE SQUARE ROUTE, BOSTON & EASTERN ELECTRIC R. R. CO.—The cut through Lynn will be done by digging two trenches each 3 ft. in width at an estimated cost of $2.00 per cu. yd., laying the concrete side walls, and then removing the core at $1.00 per cu. yd., the cost averaging $1.20 per cu. yd. for the entire job.

The slopes were figured at 1 on 1½, with standard width of roadway nearly 30 ft. on a fill and 36 ft. in a cut. Riprap slopes come at points where the embankment is subject to the action of tide waters or streams. The price of rock work includes the cost of excavating, trimming and a reasonable haulage. There is a salvage of $1.00 per cu. yd. for the rock, utilizing it as ballast and for concrete. The tunnel lining includes a ½-in. coat of pitch, with concrete to keep it in place.

The item "culverts" is assumed. A horseshoe culvert 6 ft. wide and made of reinforced concrete will cost from $8.00 to $9.00 per ft. of length, or an average of about $500 apiece. It is probable that less than 20 culverts will be required.

The cost of the Harbor Tunnel and the Subway in Boston are figured below.

Side and retaining walls—

Lynn, semi-subway	$312,980
Misc. side and retaining walls	144,570
Sumps and sewers	59,000
	$516,550

The first item is exclusive of excavation and bridges at streets. The second item covers walls located at different points in Salem, Peabody, Revere and East Boston. The last item includes two sumps to take care of sewers in the streets where the tracks are depressed.

Ballasting with stone—

15.87 miles double track × 5,800 cu. yds.	92,0[illegible] yds.
5.21 miles single track × 2,200 cu. yds.	11,5[illegible] yds.
	103,5[illegible] yds.

A price of $1.00 is allowed for the stone and [illegible] for crushing and laying.

Total cost, $207,000.

Crossings Over Other Railroads—

This item includes six steel two-track bridges, [illegible] steel single track bridge; one reinforced concrete two track bridge; one reinforced-concrete single track bridge and nine reinforced-concrete abutments.

Examples:

(1) Beverly crossing, 270 ft. span, single span through steel bridge, cost $27,250 exclusive of abutment, or about $100 per ft.

(2) Salem, Skerry St. crossing, 325 ft. span, double span through bridge, cross bent over tracks, cost $30,[illegible] exclusive of abutments, or about $94 per ft.

Total crossings over other railroads, $228,100.

Crossings at Streets and Ways.—

This item includes 97 bridges and several steel and concrete viaducts.

Total, $853,575.

Crossings Over Waterways.—

This includes 5 pile bridges, 2 steel bridges and 3 steel draws. The pile bridges are listed at $20 per lin. ft. for the ordinary two-track trestle, and at $30 per ft. for the extra high single-track trestle at Cranes and Waters River. The draws are listed at $25,000 each, which covers a rolling lift of 40 to 50 ft. span, and the necessary piers, machinery, etc.

Total, $265,150.

Track and Track Equipment.—

There are 17.9 miles of double track and 4.5 miles of single track, exclusive of sidings. Total mileage, 41.3 single track.

90-lb. rail, 141.43 tons at $33.00	$192,000
Joints every 45 ft., 10,800, at $1.25	13,500
Spikes, at $150 per mile	6,200
Ties, 16 in. × 33 ft., 103,000 at $0.65	69,000
Special work	10,350
Labor, at 20 cts. per ft	43,570
	$334,620

This amounts to $8,100 per mile of single track, excluding ballast, or $13,000 per mile with ballast.

Signaling System.—

A block signal system with interlocking switches and automatic stops is assumed. There will be towers at Revere St. and Peabody Jc., and interlocking switches at the Beverly and Boston terminals. The item also includes a telephone system connecting the passenger stations, towers and general offices.

Total, $100,000.

Stations, Exclusive of Terminal at Boston—

Salem	$15,000
Revere Beach	12,000
Lynn	10,000
Beverly	8,000
Danvers	5,000
West Lynn	5,000
Nine stations (each)	4,000
Four stations (total)	17,000
Total	$108,000

Seeding, Sodding and Fencing.—

30 miles of fence at $1.000 per mile, total	$30,000
Seeding	2,750

Power Station. Capacity Required, 8,000 KW.—

(1) Land, wharf, etc.	$4.00	per	kw.	$32,000
(2) Bldg. foundations, stack, intake sewers, fixtures.	20.00	"	"	160,000
(3) Steam equipment, boilers, stokers, piping, engines, generators, auxiliaries.	62.00	"	"	496,000
(4) Elec. equipment (except generators)	4.00	"	"	32,000
(5) Miscellaneous 10%	10.00	"	"	80,000
Total	$100.00	"	"	$800,000

Power Distributing System—

3d-rail installed, 41.3 mi. at $4,700	$194,100
Bonding track, 41.3 mi. at $500	20,650
Transmission cable, 7 mi. at $7,920	55,340
Transmission line, 16 mi. at $4,000	64,000
Terminal houses, 2 mi. at $3,000	6,000
Total	$340,090

SUMMARY OF REVISED ESTIMATE. COST OF CONSTRUCTION OF PROPOSED BOSTON & EASTERN R. R.

Grading, surfacing, Tunneling, etc.:

Cut east of High Rock	705,760	cu.	yds.	at	$0.50	$325,880
Cut in Lynn	140,400	"	"	"	1.20	168,480
Cut in Revere and Chelsea	129,150	"	"	"	1.00	129,150
Cut from Chelsea River to Curtis St	103,500	"	"	"	0.50	51,750
Cut from Curtis to Porter St	55,380	"	"	"	1.00	55,380
Cut from Porter St. to Tunnel	26,140	"	"	"	1.20	31,370
Riprap slope	36,180	sq.	"	"	0.50	18,090
Tunnel rock	89,800	cu.	"	"	4.00	339,200
Tunnel lining	30,000	sq.	"	"	1.00	30,000
Open rock cut	157,910	cu.	"	"	1.75	276,340
Tunnel portals	3,080	"	"	"	7.00	21,560
Culverts						
						$1,484,200
Credit 242,710 cu. yds. rock at $1.00						242,710
						$1,241,900

The item 3d-rail includes a low carbon rail, installed with wooden protection. The cable is listed at $1.50 per lin. ft. installed.

Substations.—

Peabody Jc., 3,000 KW.; Lynn, 3,000 KW., Revere or Chelsea, 4,000 KW. Total, 10,000 KW., at $30 per KW. for machinery and building, $300,000.

Cars and Car Equipment—

Carbody and trucks	$5,500	
4 200-HP. motor equipment	10,725	
Air brakes	500	
Miscellaneous	125	
50 cars at	$16,850	$842,500

Car Houses and Repair Shops—

Land	$15,000	
Shops for 60 cars, at $1,000	60,000	
Equipment	20,000	
Service cars	25,000	
	$120,000	$120,000

Harbor Tunnel, Subway and Terminal— $2,190,060

This item is arrived at by using the cost of the present East Boston Tunnel as a basis, omitting the items chargeable to the construction of existing passenger stations at Atlantic Ave., Old State House, and Scollay Square, and adding the estimated cost of the proposed terminal at Post-office Square, Boston (exclusive of land damage, which is included under Real Estate).

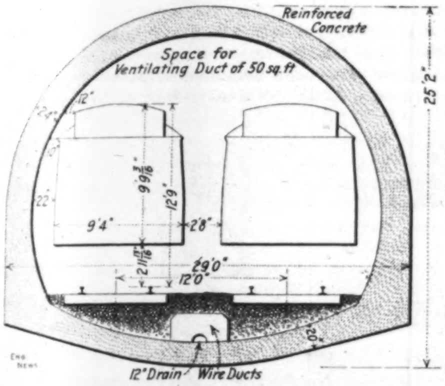

Fig. 2. Cross-Section of Proposed Tunnel Under Boston Harbor; Boston and Eastern Electric R. R.

The cost of the water section of the East Boston Tunnel, exclusive of interest, engineering and general expenses, was about $260 per lin. ft. With reinforced-concrete a tunnel can be built at the same cost with a greater interior cross section. Exclusive of the water section, the East Boston Tunnel cost $650 per lin. ft. total., but the proposed allowance for the Boston & Eastern Tunnel, exclusive of the water section, is $750 per lin. ft. There will be from 150,000 to 200,000 cu. yds. of material taken from the tunnel that cannot be used in embankments.

Engineering, Interest and Miscellaneous.—

13½% of the total cost of construction and equipment	$1,049,000
Real estate	1,444,323
Grand total	$10,973,208

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THE RAILWAY SYSTEM OF INDIA aggregated 30,010 miles in length at the end of 1907, according to the annual report of the Railway Board. At the end of March, 1908, there were 30,206 miles open and 2,516 miles authorized or under construction. The total for 1907 included 15,821 miles of 5-ft. 6-in. gage (the Indian standard gage), 12,613 miles of meter gage, 1,234 miles of 2-ft. 6-in. gage, and 342 miles of 2-ft. gage. There were 1,412 passenger engines (90.4% of total), and 2,290 freight engines (48.6%) equipped with automatic brakes; also 12,505 cars in passenger service (67%), and 10,698 freight cars (10.7%) similarly equipped. Of the passenger cars, 67% were fitted with gas and electric light; 10,677 with the former, and 2,172 with the latter. During the year, 94 stations were fitted with switch and signal interlocking apparatus, and 111 with automatic instruments for signaling trains between stations. On January 1, 1908, the old system of administration was abolished, and the railways put under government control through the medium of the present Railway Board. Train accidents resulted in the deaths of 45 passengers, 40 employees and 16 other persons. The total casualties on the railways were 1,834 persons killed and 1,665 injured. These include suicides, persons run over at grade crossings and persons hurt through their own carelessness or misconduct. The employees number 516,756, of whom only 7,180 are Europeans; there are 499,594 natives and 9,982 Eurasians. The railway schools are attended by 7,140 children and 11,678 apprentices and workmen.

INVESTIGATIONS OF THE DISTRIBUTION OF SEWAGE UPON TRICKLING FILTERS.*

By STEPHEN DeM. GAGE.†

In the purification of sewage by trickling filters, constructed of coarse materials and operated at high rates, the efficiency depends largely upon the application of the sewage as a fine spray uniformly over the whole surface, and the failure of otherwise well-designed filters to produce an effluent of good quality may often be attributed to improper application of the sewage.

Of the numerous types of distributors which have been devised, the simplest and most rational are those in which the sewage is sprayed from some form of fixed nozzle, and such systems are rapidly gaining in favor despite the well-recognized fact that they do not give a very uniform distribution. A number of investigations of the distribution by nozzle systems have been made during the past few years, the most notable being those of Taylor‡ at Waterbury, Conn., and those of Winslow-Phelps-Story and McRea§ at the Massachusetts Institute of Technology, the latter being particularly comprehensive. The whole subject of the best means of distributing sewage upon filters has been under investigation at Lawrence for more than twenty years, and during the past eight years, in connection with the operation of a large experimental trickling filter at Andover, Mass., continuous studies have been in progress to determine the most satisfactory means of distributing sewage upon filters of that type, during which time numerous measurements have been made of the amounts of sewage falling upon the various portions of the surface of the filter when operated with different forms of distribution apparatus. The different methods of distribution which have been studied at Andover are as follows:

In 1899 the distribution was by means of a grid of perforated pipes from which numerous small jets shot up into the air and were more or less completely dissipated by wind action. In 1900 the grid was elevated 1 ft. above the surface, with the orifices pointing downward; beneath each orifice was placed a flat piece of slate to spread the discharge, this being probably the first attempt at an overhead carrier system combined with dash plates to distribute the flow in this country. During the winter of 1903 and 1904 subsurface application was tried, and from 1904 to 1906 the sewage was applied by means of an automatic tipping basin which intermittently flushed one side and then the other of the bed, the distribution of the sewage being assisted by sloping the surface away from the tipping basin. In June, 1906, an improved modification of the system used in 1900, consisting of an automatic flush tank connected by overhead pipes with nozzles discharging downward upon circular plates with an upturned rim, was installed. The need of more complete data than could be obtained at Andover led to the installation of a special testing apparatus at the Experiment Station in the spring of 1906, since which time the studies have been continually in progress.

In these investigations it has been attempted to determine the fundamental principles which underlie the action of different types of sprinklers, in order to ascertain by what combination of these principles we shall be able to obtain the most perfect distribution of sewage upon the surface of a filter. To this end, we have measured the distribution by a number of different sprinklers when operated under a wide range of conditions, varying each factor independently to determine its effect upon the distribution. With the underfed sprinklers we have studied the operation at all heads between 2 ft. and 8 ft., the effect of varying the head during discharge through different limits, the effect of placing the sprinklers at different elevations above the surface, and the effect of the different angles of discharge. With the overfed or dash-plate sprinklers, the effect of varying the size of the discharging orifice, of varying the diameter of the plate and of varying the angle and width of the deflecting rim have been studied. Since the underlying principles of both overfed and underfed sprinklers are the same, it has been unnecessary to repeat all of the tests with each type of sprinkler.

In addition to the studies of the distribution upon the surface of filters, investigations are in progress to determine what effect, if any, the material in a filter may have upon the distribution.

It should be stated at this point that throughout the following discussion the word *head* has been used only to denote the head on the sprinkler, the available head being denoted by the expression *working distance*.

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*The investigations here reported were made at the Lawrence Experiment Station of the Massachusetts State Board of Health, at Lawrence, Mass., under the direction of Mr. H. W. Clark, Chemist of the Board. Messrs. James Spurr and A. W. Kimball have assisted in making the tests and Miss Mary J. Lynch has assisted in computing and compiling the various results.

†Lawrence Experiment Station, Lawrence, Mass.

‡Eng. Rec., Jan. 5, 1907, p. 10.

§Technology Quarterly, XX, 1907, p. 325. Also in abstract, Eng. News, Jan. 9, 1908.—Ed.

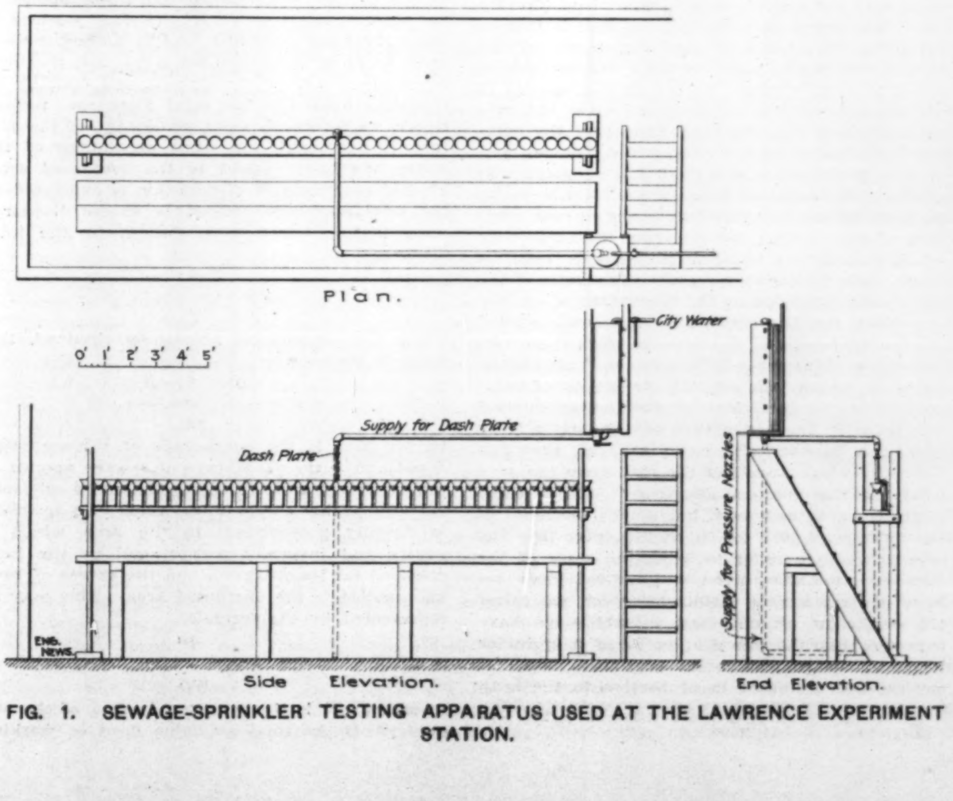

FIG. 1. SEWAGE-SPRINKLER TESTING APPARATUS USED AT THE LAWRENCE EXPERIMENT STATION.

DESCRIPTION OF THE TESTING APPARATUS AND METHOD OF TESTING.—The testing apparatus is located within the Experiment Station, where it is independent of wind and weather conditions and consists of a wooden platform supported upon crossbeams bolted to uprights at either end, the uprights being pierced with holes 1 ft. apart to allow the platform to be raised or lowered at will. Upon this platform stand 40 bottles, each containing a funnel 6 ins. in diameter, the bottles being so spaced that the rims of adjacent funnels touch. At one side of this platform is an elevated galvanized iron tank with a gage showing the elevation of the water, and gates for the inflow and outflow so arranged that one operator can conveniently control the starting and stopping of the flow to the sprinkler and maintain the head at any desired point. From this tank, lines of clean 2-in. galvanized iron pipe lead to above and below the center of the adjustable platform and suitable lengths of pipe are provided in order that the sprinklers may be placed at any desired elevation. The piping connecting the supply tank with the sprinklers is of sufficient size so that there shall be no appreciable loss of head due to the friction of the water flowing through the piping system. With this apparatus we are able to vary the working distance, the head, and the riser distance independently, and with a supply of nozzles and dash plates of different types, to study the effect of different combinations upon the distribution, and by rotating any sprinkler upon its axis to determine the relative distribution upon different portions of the filter surface. The construction of the apparatus is shown in Fig. 1. In making a test, the adjustable platform is placed at the proper elevation, the sprinkler is connected with the supply pipes and adjusted so that its axis of discharge is vertical. The water is then allowed to flow under a constant head for a definite time, or the level of the water in the supply tank is allowed to fall through the desired range and the volume of water collected in each bottle is measured. When testing sprinklers which produce a circular spray, the sprinkler is then rotated through an angle of 90° and the operation repeated. In testing sprinklers which do not produce a circular discharge, the operation is similar, except that it is necessary to make a number of measurements with the sprinkler rotated through small angles.

EXPRESSION OF RESULTS.—A number of factors enter into a comparison of the efficiency of different sewage sprinklers. It is important that the rate of discharge and the size of the area wet be known, since upon these factors must be based the location of the sprinklers upon the filtration area, and the design of the carrier system to supply sewage to the sprinklers. Upon the uniformity with which the sewage is distributed over the surface, and upon the rate at which it is applied, depends in part the purification effected by the filter, while economy and ease of maintenance require that the construction of the sprinkler be such that it shall not be easily clogged and may be readily cleaned in case clogging should occur. In comparing the uniformity of distribution a number of methods may be used. In a preliminary report* the results of the tests were expressed as the percentage of surface overdosed and the percentage of sewage applied to that surface, and the ratio between these two percentages furnishes a simple and convenient basis of comparison. A similar means of comparison is the coefficient of distribution devised by Phelps†. Another method of comparison is by the ratio between the mean rate of discharge upon the whole area and the rate upon the area receiving the greatest discharge. All of these methods have their uses, but none include all of the various factors which should enter into the comparison. In order to bring the work of the different sprinklers upon a practical basis we have devised a new coefficient which we called the coefficient of efficiency, in which we have assumed that the practical value of a sprinkler increases in proportion to the area which it covers, and decreases in proportion to the head necessary for its operation and to the excess of sewage applied to the overdosed area.

Let us now consider the computation of these various factors. With the apparatus described, the area wet by any sprinkler which produces a circular spray is divided into concentric rings each 0.5 ft. wide, upon which the fall of water is caught at two or more points by the collecting funnels, which are arranged as radii of the circle wet. The diameters of these rings have been expressed in all cases as outside diameters and not as mean diameters.

To obtain the total quantity of water falling on each ring the catch on each unit area must be multiplied by a factor expressing the ratio of the area of the ring to the area of the collecting funnel, this factor being represented by the formula $4(2N - 1)$ in which N is the outside diameter in feet of the concentric ring. The sum of the catch on all the concentric rings has been assumed to be the total discharge. The mean unit discharge, or theoretical discharge upon the unit area, is determined by dividing the total discharge by the number of unit areas in the entire area wet, which factor may be represented by the formula $4D^2$, in which D is the outside diameter in feet of the wet area. By comparing the mean unit discharge with the actual catch upon the various unit areas we determine what portions of the surface are overdosed, and by adding the relative areas of the overdosed rings, and the total catch upon each of those rings, and dividing by the total area and the total discharge, respectively, we determine what percentage of the surface is overdosed and what percentage of the water has been applied to the overdosed area. Phelps' coefficient of distribution is expressed as the total discharge, minus the excess discharge upon the overdosed area, divided by the total discharge, or,

$$C = \frac{T - E}{T}$$

Using the percentages previously obtained, this formula becomes

$$C = \frac{100 + A - B}{100}$$

in which A is the percentage of surface overdosed and B the percentage of sewage applied to the overdosed area. In the coefficient of efficiency we assume that the practical value of a sprinkler is directly proportional to the area which it covers and inversely proportional to the head required for its operation and the excess of sewage applied to the overdosed area. This may be represented by the formula

$$E = \frac{D^2}{WO},$$

in which D is the diameter, in feet, of the wet area, W is the total available head or working distance, and O is the difference between the percentage of surface overdosed and the percentage of sewage applied to that area.

TESTS WITH UNDERFED SPRINKLERS.

The underfed sprinklers may be divided into three general classes according to the method by which the spray is produced. In the Columbus and Birmingham types, the spray is produced by a deflecting cone placed above the orifice of discharge, the two differing in principle only in the manner in which the deflector is supported; in the Columbus type the supports are external, interfering with the projection of the spray as a true circle, but leaving an unobstructed waterway through the discharging orifice, while in the Birmingham type the cone is supported by a rod running down through the orifice to a seat inside the nozzle, the flow through the orifice being in the form of a hollow cylinder and the projection of the spray being unobstructed. In the new-style Salford type the spray is produced by centrifugal action, a whirling motion being imparted to the sewage within the nozzle, while in the old-style Salford type the spray is produced outside the nozzle by the interference of two streams of sewage which meet at an angle. All of these nozzles are designed to be screwed into a vertical riser and are fed from below. The construction of these sprinklers is shown in Fig. 2.

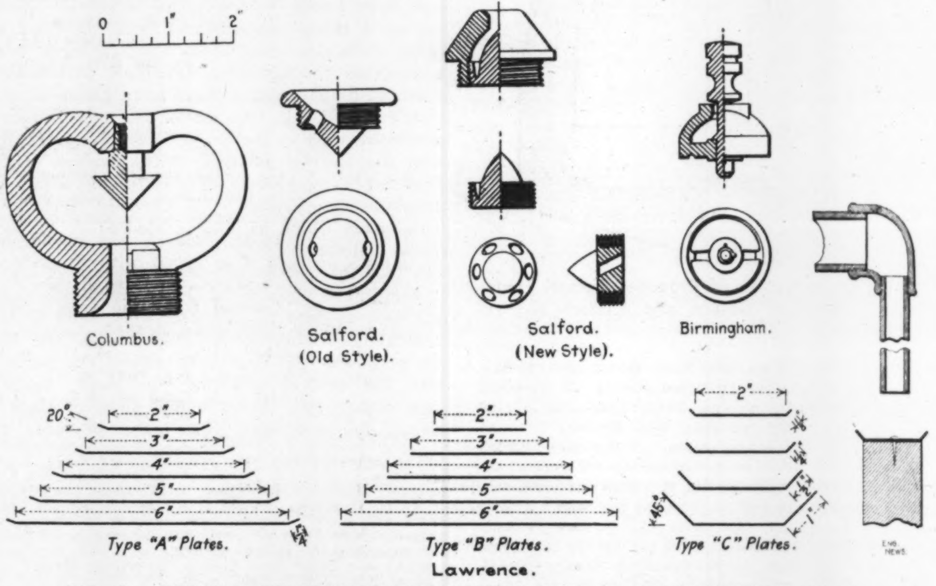

FIG. 2. DETAILS OF SEWAGE SPRINKLERS TESTED AT LAWRENCE, MASS.

COLUMBUS SPRINKLER.—In the original design, the angle of the deflecting cone of this sprinkler was 90° and the point of the cone was placed ½-in. above the orifice, but for the purpose of experiment, we have added two other cones with angles of 102° and 120°, respectively, and we have made tests with the point of the cone lowered to the plane of the orifice. The effect of the arms supporting the cone has been to deflect the spray out of its proper course, resulting in an unequal discharge upon different radii. In Figs. 3 and 4 are shown the distribution fields of this sprinkler equipped with the 90° cone. The contour lines show equal volumes of water falling upon unit areas, expressed as percentages of the theoretical discharge upon the unit area. The plots show characteristic differences in the distribution by the sprinkler when operated under constant and variable head, the volumes falling upon different unit areas being far more uniform under constant head than under variable head. Taylor reports that at Waterbury considerable trouble was caused by fungous growths upon the arms of this sprinkler when operated with sewage, under which conditions the inequalities in distribution would be considerably accentuated.

As this study has been mainly one of principles, all results have been computed from the discharge upon the radii at right angles to the deflecting arms where there was no interference, corrections for unequal discharge on different being omitted. Under constant head the Columbus sprinkler with the 90° cone covered circles varying from 4 ft. in diameter with 2 ft. to 17 ft. in diameter with 8 ft. head, with a discharge of from 5.25 to 13.05 gals. per min., respectively. As the area wet by any nozzle increases much faster with the increase in head than does the discharge, the result is that the rate on the area wet decreases as the head increases, this rate being 27.16 million gallons per acre daily for 2 ft. head, and 3.77 million gallons per acre daily for 8-ft. head. The most uniform distribution was obtained with a head of 7 ft., when 82% of the sewage was applied to 43% of the surface, the area covered being 14 ft. in diameter, the mean rate being 4.98 million gallons per acre daily and the rate on the ring receiving the maximum overdose being 14.50 million gallons per acre daily, the coefficient of distribution being 0.61.

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*1906 Report Mass. State Board of Health, p. 244.

†Eng. News, Oct. 11, 1906.

Under variable head the most uniform distribution occurred with the nozzle 1 ft. above the surface, a working distance of 8 ft., and a variation in head of 2 ft. Under these conditions an area of 13 ft. in diameter was wet, in which 71% of the sewage was applied to 38% of the surface, the distribution coefficient being 0.67.

The Columbus nozzle with the 102° cone under constant head covered circles varying in diameter from 5 ft. under 2 ft. head to 18 ft. under 8 ft. head, the rate on the wet area being 19.7 million gallons and 2.64 million gallons per acre daily, respectively, and the discharge 5.97 and 11.90 gals. per min., respectively. The most uniform distribution was obtained under a head of 7 ft., with the nozzle on the surface, when 80% of the sewage was applied to 42% of the surface, the area wet being 15 ft. in diameter, the mean rate being 4.40 million gallons per acre daily and the rate on the ring receiving the maximum overdose being 10.70 million gallons per acre daily, the coefficient of distribution being 0.62.

Under variable head the most uniform distribution occurred with the nozzle on the surface, a working distance of 8 ft. and a variation in head of 3 ft. Under these conditions an area 15 ft. in diameter was wet, in which 77% of the sewage was applied to 42% of the surface, the distribution coefficient being 0.65.

The Columbus nozzle with the 120° cone under constant head covered circles varying in diameter from 5 ft. under 2 ft. head to 18 ft. under 8 ft. head, the rate on the wet area being 23.1 million gallons and 3.50 million gallons per acre daily, respectively, and the discharge 6.93 and 13.70 gals. per min., respectively. The most uniform distribution was obtained under a head of 7 ft., with the nozzle 1 ft. above the surface, when 77% of the sewage was applied to 40% of the area wet, the area wet being 17 ft. in diameter, the mean rate being 3.70 million gallons per acre daily and the rate on the ring receiving the maximum overdose being 9.50 million gallons per acre daily, the coefficient of distribution being 0.63.

Under variable head the most uniform distribution occurred with the nozzle on the surface, a working distance of 8 ft. and a variation in head of 3 ft. Under these conditions an area 15 ft. in diameter was wet, in which 77% of the sewage was applied to 42% of the surface, the distribution coefficient being 0.65.

The above results were obtained with cones placed ½-in. above the orifice. The effect of lowering the cones to the plane of the orifice was to throttle the discharge, the rate with the 90° cone being reduced 25%, that with the 102° cone being reduced 20% and the rate with the 120° cone being reduced 15%. Under constant head the area wet by the 90° and 102° cones was reduced 15% and 20%, respectively, but no reduction was noted with the 120° cone. With a 4-ft. variation in head the area covered by the 90° cone was reduced 17%, but no contraction occurred with the other two cones. When operated under constant head the distribution by all the cones was more uniform when they were placed close to the orifice, and under variable head the distribution by the 90° cone was also improved, but with the other two cones the uniformity was slightly decreased. The tests of the sprinklers with cones lowered to the plane of the orifice were made with the nozzle on the surface and a working distance of 5 ft.

BIRMINGHAM SPRINKLER.—With this nozzle the distribution was somewhat more uniform than with the Columbus nozzles, but the ports are of such small size that much trouble would be experienced with clogging unless operated with a sewage free from suspended matter.

Under constant head the Birmingham sprinkler covered circles varying in diameter from 7 ft. under 2 ft. head to 15 ft. under 8 ft. head, the discharge being 2.13 and 3.91 gals. per min., respectively, and the rate on the wet area being 3.61 million gallons per acre daily under the lower head and 1.45 million gallons per acre daily under the higher head. The most uniform distribution was obtained with this nozzle under a head of 5 ft., with the nozzle on the surface, when 44% of the sewage was applied to 27% of the area wet, this area being 13 ft. in diameter, the mean rate being 2.35 million gallons per acre daily and the rate on the ring receiving the maximum overdose being 4.6 million gallons per acre daily, the coefficient of distribution being 0.83. Under variable head the most uniform distribution was obtained with the nozzle 1 ft. above the surface, and a working distance of 7 ft., under which conditions an area 13 ft. in diameter was wet, 77% of the sewage being applied to 43% of this area, the distribution coefficient being 0.66.

SALFORD NEW-STYLE SPRINKLER.—The areas covered by this sprinkler are smaller than those covered by either the Columbus or Birmingham types, owing to the considerable loss of head within the nozzle, but the distribution has been quite uniform. On account of the small size of the ports, this nozzle would become quickly clogged if operated with American sewages, and the construction is such that it would have to be removed from the riser and taken apart before it could be cleaned.

Under constant head the Salford new-style sprinkler covered circles varying in diameter from 4 ft. under 2 ft. head to 14 ft. under 8 ft. head, the rate on the wet area being 6.6 million gallons and 1.4 million gallons per acre daily, respectively, and the discharge 1.25 and 3.30 gals. per min., respectively. The most uniform distribution was obtained under a head of 5 ft., with the nozzle on the surface, when 76% of the sewage was applied to 51% of the area wet, the area wet being 9 ft. in diameter, the mean rate being 2.6 million gallons per acre daily, the rate on the ring receiving the maximum overdose being 4.3 million gallons per acre daily, and the coefficient of distribution being 0.75.

Under variable head the most uniform distribution was obtained with the nozzle on the surface, and a working distance of 7 ft., when an area 11 ft. in diameter was wet, 75% of the sewage being applied to 41% of the surface, the distribution coefficient being 0.68.

SALFORD OLD-STYLE SPRINKLER.—This nozzle would probably cause trouble by clogging, but owing to its simple construction it could be readily cleaned. The discharge upon different radii by this sprinkler is not the same, the shape of the area wet being not unlike two lobes of a clover leaf, with the greatest amount of sewage falling in the centers of the lobes. The field of distribution is shown in Fig. 3, in which the contour lines show equal volumes of sewage falling upon unit areas expressed as percentages of the theoretical discharge. The shape of the area wet by this sprinkler was similar when operated under constant or under variable head. For the purpose of comparison the area wet by this nozzle has been computed as an ellipse, and the rings have been figured as elliptical rings, a comparison of the results obtained from the plots and of those obtained by computing the areas as an ellipse having shown that the error of such a computation is well within the error of testing.

Under constant head the Salford old-style sprinkler covered elliptical areas varying in size from 4 × 2 ft. under 2 ft. head to 17 × 7 ft. under 8 ft. head, the rate on the wet area being 27.3 million gallons and 3.6 million gallons per acre daily, respectively, and the discharge 2.64 and 5.13 gals. per min., respectively. The most uniform distribution was obtained under a head of 7 ft., with the nozzle 1 ft. above the surface, when 75% of the sewage was applied to 46% of the area wet, the dimensions of the area wet being 15 × 7 ft., the mean rate being 5.2 million gallons and the rate on the ring receiving the maximum overdose being 14.6 million gallons per acre daily, the coefficient of distribution being 0.71.

Under variable head the distribution was much less uniform than under constant head, the effect of varying the head being to concentrate a considerable proportion of the sewage upon a small area near the nozzle. The most uniform distribution occurred with the nozzle on the surface and a working distance of 8 ft., the dimensions of the area wet being 15 × 6 ft., within which 68% of the sewage was applied to 24% of the surface, the coefficient of distribution being 0.56.

The mean rates upon the wet area and the efficiency coefficients for the various underfed sprinklers are shown in Tables I. and II.

TESTS WITH OVERFED SPRINKLERS.

In the overfed or dash-plate sprinkler of the type used on the experimental filter at Andover and employed in these tests, the sewage is conveyed overhead in pipes to a brass nozzle 3 ins. long, of uniform bore, through which it is discharged upon a copper dash plate supported upon an independent standard. The details of this type of sprinkler, as used on the Andover experimental filter and the different types of dash plates tested are shown in Fig. 2. All of the plates have been tested at a uniform working distance of 6 ft., with the plate 1 ft. above the surface and 1 in. below the orifice.

TYPE A, DASH-PLATE SPRINKLER.—This type includes five circular plates, varying from 2 to 6 ins. in diameter, with a rim 0.25-in. in diameter turned up at an angle of 20°. Each plate was tested with five different nozzles having diameters of 0.25, 0.38, 0.50, 0.63, and 0.75-in., respectively. The plate 2 ins. in diameter gave a more satisfactory distribution than did any of the larger plates, the effect of increasing the diameter of the plate being to retard the flow so that a smaller area was covered, the friction being so great with the larger plates that an area only about 2 ft. in diameter was wet when using the smallest orifice. With the 2-in. plate and an orifice 0.25-in. in diameter an area 9 ft. in diameter was wet, the rate of discharge being 2.4 gallons per minute, the mean rate 2.5 million gallons, and the maximum rate upon the overdosed area 5.8 million gallons per acre daily, 78% of the sewage being applied to 41% of the surface, and the coefficient of distribution being 0.63. An interesting fact noted in these tests was that under constant head the diameter of the area wet was less in every case when an orifice of 0.75-in. in diameter was used than when an orifice 0.63-in. in diameter was used, notwithstanding the fact that the rate of discharge was proportionately greater with the larger orifice. Under variable head the distribution by this type of plate was much more uniform with large orifices than with the smaller orifices, the best results being obtained with a 2-in. plate and an orifice of 0.63-in. in diameter. Under these conditions an area 12 ft. in diameter was wet, 81% of the sewage was applied to 44% of the surface and the distribution coefficient was 0.63.

TYPE B, DASH-PLATE SPRINKLER.—This type includes five perfectly flat circular plates, varying in diameter from 2 to 6 ins., each of which has been tested with three nozzles having orifices of 0.25, 0.50 and 0.75-in., respectively. The results obtained in these tests were similar to those obtained with the Type A plate, the principal difference being the somewhat smaller areas covered. Under constant head the distribution was more uniform with the smaller orifices, although this did not hold true when the sprinklers were operated under variable head. Under constant head the best results were obtained with a 4-in. plate and 0.25-in. orifice when a distribution coefficient of 0.57 was obtained,

TABLE II.—EFFICIENCY COEFFICIENTS FOR UNDERFED SEWAGE SPRINKLERS.

Working distance, ft.	Riser distance, ft.	Constant Head: Columbus. 90°	Constant Head: Columbus. 102°	Constant Head: Columbus. 120°	Constant Head: Birmingham.	Constant Head: Salford. New style.	Constant Head: Salford. Old style.	Variabe Head: Columbus. 90° 2 ft.	Variabe Head: Columbus. 90° 3 f.t	Variabe Head: Columbus. 90° 4 ft.	Variabe Head: Columbus. 102° 2 ft.	Variabe Head: Columbus. 102° 3 ft.	Variabe Head: Columbus. 102° 4 ft.	Variabe Head: Columbus. 120° 2 ft.	Variabe Head: Columbus. 120° 3 ft.	Variabe Head: Columbus. 120° 4 ft.	Variabe Head: Birmingham. 4 ft.	Variabe Head: Salford. New style. 4 ft.	Variabe Head: Salford. Old style. 4 ft.
2	0	.16	.20	.26	.40	.15	.07	...	...	...	...	...	...	...	...	...	...	...	...
3	0	.48	.61	.61	.61	.32	.11	.20	...	...	.24	...	...	.27	...	...	...	...	...
3	1	.19	.34	.37	.47	.44	.06	...	...	...	...	...	...	...	...	...	...	...	...
4	0	.53	.71	.67	.70	.49	.13	.34	.28	...	.47	.42	...	.37	.36	...	...	...	...
4	1	.45	.56	.58	.70	.49	.10	...	...	...	...	...	...	...	...	...	...	...	...
5	0	.63	.74	.79	2.00	.65	.20	.55	.45	.44	.64	.51	.56	.60	.56	.54	.51	.42	.08
5	1	.46	.68	.74	.82	.67	.16	.35	.27	.27	.41	.51	.46	.59	.56	.50	.48	.42	.10
6	0	.61	.77	.78	.80	.75	.26	.49	.47	.50	.59	.59	.74	.66	.66	.78	.57	.39	.17
6	1	.59	.72	.75	1.29	.69	.22	.53	.52	.40	.63	.66	.52	.63	.55	.56	.65	.41	.09
7	0	.72	.85	.87	.56	.81	.23	.65	.56	.53	.72	.70	.75	.70	.70	.72	.59	.51	.23
7	1	.65	.73	.75	.87	.75	.28	.55	.49	.54	.64	.64	.67	.72	.66	.70	.71	.54	.14
8	0	.84	.94	1.04	.91	.88	.40	.74	.66	.67	.84	.74	.87	.87	.74	.78	.68	.57	.26
8	1	.73	.92	.98	1.00	.88	.45	.64	.60	.54	.74	.76	.70	.58	.76	.78	.80	.64	.21
8	2	.64	...	.73	...	...	...	.51	.48	.56	...	...	...	.68	.64	.66	...	...	...
8	3	.68	...	.52	...	...	...	.44	.43	.38	...	...	...	.54	.59	.61	...	...	...

the area covered, 4 ft. in diameter, being so small, however, that the sprinkler could have no practical value. Under variable head the best result was obtained with a 3-in. plate and 0.75-in. orifice, the area covered in this case being 8 ft. in diameter, upon which 76% of the sewage was applied to 33% of the surface, corresponding to a uniformity coefficient of 0.57.

TYPE C, DASH-PLATE SPRINKELR.—This type includes four 2-in. plates with rims 0.13, 0.25, 0.50 and 1 in. wide turned up at an angle of 45°, each of which was tested with an orifice ½-in. in diameter.

Under constant head the areas wet were slightly less with the larger plates than with the smaller, and the distribution was somewhat more uniform with the smallest and the largest plate than with the other two. The best result under constant head was obtained with the plate having a rim only 0.13-in. wide, an area 13 ft. in diameter being covered, upon 27% of which area 70% of the sewage was applied. The rate on the wet area in this test was 4.9 million gallons per acre, the maximum rate on the overdosed area being 16.2 million gallons per acre daily, the coefficient of distribution being 0.57. The results obtained under variable head with the three plates having the wide rims were practically identical, the distribution coefficients being 0.51, 0.49 and 0.51, respectively. The results obtained with the plate having the narrowest rim were somewhat better than with the other plates. With this plate an area 11 ft. in diameter was wet, 83% of the sewage being concentrated upon 40% of the surface, with a distribution coefficient of 0.57. The rates upon the area wet and the efficiency coefficients for the various overfed sprinklers are shown in Tables III. and IV.

TABLE I.—MEAN RATES ON AREA WET BY UNDERFED SEWAGE SPRINKLERS UNDER CONSTANT HEAD. (Million Gallons per Acre Daily.)

Working distance, ft.	Riser distance, ft.	Columbus 90°	Columbus 102°	Columbus 120°	Salford New style.	Salford Old style.	Birmingham.
2	0	27.6	19.7	23.1	6.6	27.3	3.6
3	0	8.3	6.7	6.7	4.3	9.6	2.4
3	1	16.0	8.2	8.2	3.1	21.2	2.4
4	0	7.0	4.8	5.3	2.9	8.2	1.8
4	1	7.2	5.6	5.4	2.2	10.8	1.6
5	0	5.8	4.7	5.1	2.6	6.9	2.4
5	1	6.8	3.9	3.9	1.7	6.4	1.3
6	0	5.2	4.1	4.5	2.0	3.4	1.8
6	1	5.0	5.3	3.9	1.7	4.3	1.7
7	0	5.0	4.4	4.0	1.6	5.4	1.3
7	1	4.4	3.9	3.1	1.5	3.9	1.4
8	0	3.8	2.6	3.5	1.4	3.6	1.5
8	1	3.6	3.5	3.7	1.4	5.2	1.0
8	2	4.0	...	4.2	...	...	...
8	8	3.2	...	4.4	...	...	...

COMPARATIVE EFFICIENCY OF DIFFERENT SPRINKLERS.

The relative efficiency of the different underfed sprinklers varied considerably, depending upon the working distance and upon whether operated under constant or variable head. Taking all common tests into consideration, the relative efficiencies of the different sprinklers when operated under constant head rank in the following order: Birmingham, Columbus 120°, Columbus 102°, Salford New Style, Columbus, 90°, Salford Old Style. The relative order is slightly different in some positions, the Salford New Style and the Columbus 90° changing places occasionally. The Birmingham sprinkler was in every case the most efficient and the Old Style Salford the least efficient of the underfed sprinklers tested under constant head. The order of the underfed nozzles in the scale of efficiency was quite different when operated under variable head. The Columbus 120°, Columbus 102° and Birmingham sprinklers changed places frequently in different positions, so that it is difficult to rank them accurately, the Columbus 120° nozzle being perhaps slightly better than the other two, with the Columbus 102° second, the Birmingham a very close third, the Columbus 90°, the Salford New Style and the Salford Old-Style nozzles following in the order named. As the dash plates were tested only with a working distance of 6 ft., with the sprinkler 1 ft. above the surface, these are the conditions under which we must compare the overfed and the underfed types. Disregarding the effect of different sizes of dash plates and of different discharging orifices, and selecting the greatest efficiencies for each type of dash plate, we find that under constant-head tests the Type A plate was less efficient than the Birmingham, the Columbus 120° and the Columbus 102° nozzles, and more efficient than the other types. The Type C plate ranked somewhat lower in the scale of efficiencies, being better than the Columbus 90° and Salford Old-Style nozzles, and less efficient than the other types. The Type B

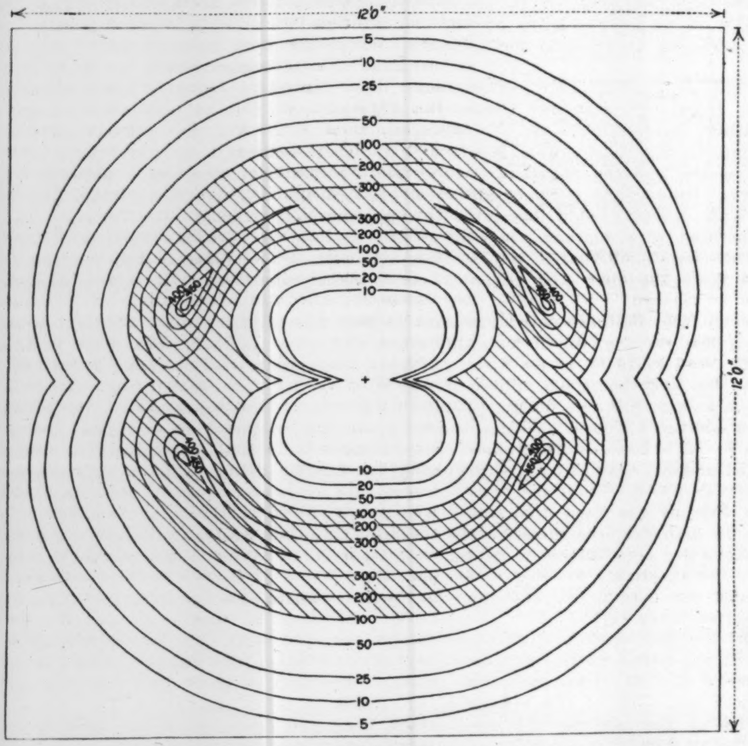

FIG. 3. COLUMBUS 90° SPRINKLER WITH 5-FT. CONSTANT HEAD.

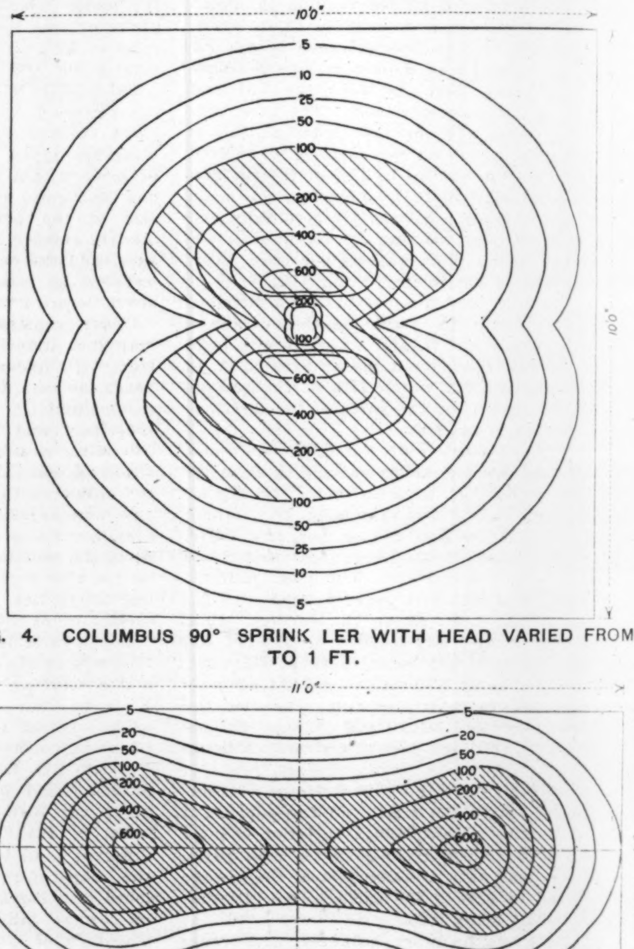

FIG. 4. COLUMBUS 90° SPRINK LER WITH HEAD VARIED FROM 5 TO 1 FT.

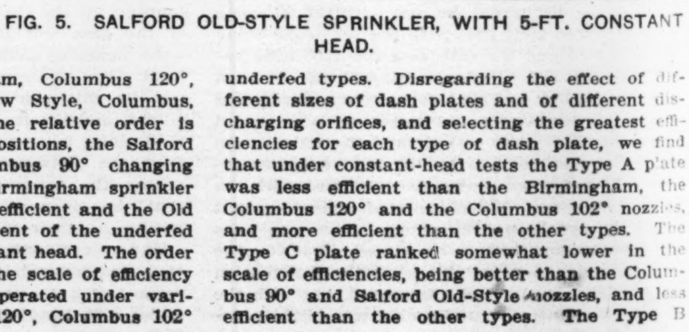

FIG. 5. SALFORD OLD-STYLE SPRINKLER, WITH 5-FT. CONSTANT HEAD.

FIGS. 3 TO 5. DISTRIBUTION EFFECTED BY COLUMBUS AND BY SALFORD SEWAGE SPRINKLERS.

(Nozzles on surface in each case. Cross-hatched portions represent areas overdosed.)

TABLE III.—MEAN RATES ON AREA WET BY OVER-FED SEWAGE SPRINKLERS UNDER A CONSTANT HEAD OF 5 FT., WITH SPRINKLER 1 FT. ABOVE THE SURFACE. (Million Gallons per Acre Daily.)

Type of plate.	Diameter, ins.	Width of rim, ins.	Diameter of orifice, ins. .25	.38	.50	.63	.75
A.	2	.25	2.5	2.8	3.9	5.8	9.0
A.	3	.25	4.1	4.0	5.2	7.3	11.3
A.	4	.25	9.1	3.9	4.7	6.7	12.3
A.	5	.25	...	7.5	6.0	9.3	9.7
A.	6	.25	...	...	7.1	...	11.8
B.	2	.25	4.9	...	9.0	...	20.8
B.	3	.25	6.8	...	8.9	...	15.7
B.	4.	.25	18.4	...	11.4	...	18.1
B.	5	.25	...	...	14.7	...	23.4
B.	6	.25	...	...	20.2	...	32.2
C.	2	.13	...	...	4.9	...	...
C.	2	.25	...	...	4.7	...	...
C.	2	.50	...	...	5.2	...	...
C.	2	1.00	...	...	5.3	...	...

TABLE IV.—EFFICIENCY COEFFICIENTS FOR DASH PLATE SEWAGE SPRINKLERS.

Type of plate.	Diameter, ins.	Width of rim, ins.	Diameter of orifice, ins. Constant head .25	.38	.50	.63	.75	Variable head, 4′ .25	.38	.50	.63	.75
A.	2	.25	.36	.55	.64	.71	.59	.25	.44	.57	.65	.55
A.	3	.25	.12	.33	.47	.50	.55	.13	.25	.37	.46	.40
A	4	.25	.58	.36	.46	.53	.52	.58	.16	.35	.47	.43
A.	5	.25	...	.14	.37	.47	.45	...	.12	.28	.41	.41
A.	6	.25	...	...	.29	...	.39	...	...	.23	...	.36
B.	2	.25	.13	...	.30	...	.25	.11	...	.24	...	.24
B.	3	.25	.09	...	.26	...	.28	.07	...	.23	...	.25
B.	4	.25	.06	...	.20	...	.24	.06	...	.19	...	.23
B.	5	.25	...	...	.15	...	.18	...	...	.15	...	.18
B.	6	.25	...	...	.09	...	.17	...	...	.12	...	.06
C.	2	.13	...	...	.66	...	...	...	...	.47	...	...
C.	2	.25	...	...	.56	...	...	...	...	.34	...	...
C.	2	.50	...	...	.50	...	...	...	...	.40	...	...
C.	2	1.00	...	...	.53	...	...	...	...	.34	...	...

plate ranks next to the last, with a coefficient lower than that of any other type except the Old-Style Salford, which it surpassed only slightly. Under variable head the Type A plate was fully as efficient as the Birmingham nozzle, giving results much better than any of the other types, the relative position of the Type B plate and Type C plate being unchanged.

EFFECT OF THE WORKING DISTANCE.

As a rule the efficiency of all of the sprinklers tested increased as the working distance was increased. Under constant head the Columbus 102°, the Columbus 120° and the two Salford sprinklers follow this rule absolutely and the Columbus 90° results show only one exception. The Birmingham sprinkler follows the rule less closely, although the same general upward tendency may be seen. Under variable head all the sprinklers show the same general tendency, although there are exceptions in every series except those with the Birmingham sprinkler.

EFFECT OF ELEVATING SPRINKLER ABOVE THE SURFACE.

In general the results show that the sprinklers are more efficient when placed close to the surface of the filter, thus utilizing all of the available head in the operation of the sprinkler, although the different sprinklers varied among themselves in this respect, with the three Columbus nozzles the efficiency coefficients were usually greatest when the nozzles were placed on the surface of the filter, decreasing as the riser distance was increased. With the Birmingham nozzle the efficiency was greater under low heads with the nozzle on the surface, but under the higher heads the efficiency was greater with the sprinkler elevated above the surface. The Salford New-Style nozzle gave slightly better results when elevated than when placed upon the surface, although the difference between the results obtained in either position was not very great. With the Old-Style Salford nozzle the results were better with the sprinkler on the surface when operated under variable head and under the lower constant heads, but under the higher constant heads the results were better when the nozzle was elevated above the surface.

EFFECT OF VARYING THE HEAD.

The object of varying the head upon a sprinkler while it is operation is to apply the sewage to those portions of the surface adjacent to the sprinkler beyond which the sewage would be thrown if the head was kept constant. While this object has been obtained in the tests, varying the head has caused a greater proportion of the dose to be concentrated upon a much smaller area than would be the case under constant head, the distribution becoming less uniform as the variation in head increased. The result has been that in nearly every case the efficiency coefficients are greater when the sprinklers were operated with a constant head than when the head was varied. In the tests with the three Columbus sprinklers, in which the heads were varied through 2, 3 and 4 ft., respectively, the efficiency was generally greatest when the variation in head was least. Exceptions might be made in the case of the Columbus 120° nozzle, the coefficients being slightly better under the larger variations in head, but the differences are so small as to be almost within the limits of error.

EFFECT OF ANGLE OF DISCHARGE.

The results of tests of the three Columbus sprinklers and of the three types of dash plates are generally in accord with reference to the effect upon the efficiency of the angle at which the spray is projected. The Columbus 120° sprinkler which projected the spray at an angle of 30° above the horizontal was more efficient, except in a very few instances, than were either the Columbus 102° or the Columbus 90° sprinklers whose discharging angles were 39° and 45°, respectively. The Birmingham nozzle which had a discharging angle of 15° was even more efficient than the Columbus 120° nozzle, although the difference in the size of the orifice of these two types makes accurate comparison impossible. The Type A dash plate with a discharging angle of 20° was more efficient than either the Type B plate which projected the spray horizontally or the Type C plate whose angle of discharge was 45°. The proper angle at which the sewage should be projected by a sprinkler equipped with a deflecting cone or plate, in order to obtain the greatest efficiency, appears to lie between 15° and 30° above the horizon.

EFFECT OF SIZE OF DISCHARGING ORIFICE.

The only studies completed in which orifices of varying size in the same sprinkler may be compared are those made with the Types A and B dash plates. From these tests it appears that sprinklers equipped with medium or large-sized orifices are more efficient than when the orifices are very small. With the Type A plate, the greatest efficiency was obtained with an orifice 0.63-in. in diameter, the efficiency of the 0.50-in. orifice being greater than that of the 0.38-in. orifice, and that of the 0.38in. orifice being greater than that of the 0.25-in. orifice. The sprinkler with the 0.75-in. orifice was less efficient than with an 0.63-in. orifice, although the difference in the efficiency was usually small, but was considerably more efficient than when fitted with orifices 0.50-in. in diameter or smaller. The Type B sprinkler was tested only with three different orifices, and in general the rule stated above holds true that the efficiency is better with larger orifices than with very small ones. With a 2-in. plate the 0.50-in. orifice gave greater efficiency than orifices 0.25 or 0.75, but with the larger plates the 0.75-in. orifice gave slightly better results than the 0.50-in. orifice, and very much better results than the 0.25- in. orifice.

EFFECT OF WIDTH OF RIM AND SIZE OF DASH PLATES.

Taking all tests with the Type A and Type B plates, the efficiencies are greater with the smaller plates, decreasing as the size of the plate increased. A number of fluctuations are noted, but these are so small that they are within the limits of error. The only notable exception is in the Type A dash plate operated with a 0.25-in. orifice, in which case the 4-in. plate gave much better results under both constant and variable head than did the smaller plates. From the few tests with the Type C plate it appears that the plate with the narrowest rim was most efficient. The efficiencies of the other three Type C plates varied among themselves and the results are too few to establish any rule.

EFFECT OF FILTERING MATERIAL ON DISTRIBUTION.

In considering the subject of distribution of sewage by fixed sprinklers, the question naturally arises as to what effect the filtering material may have upon that distribution. It is believed by some authors that the unequal discharge upon different portions of the surface of a filter by a sprinkler would be distributed by the filtering material, and that the flow through different portions of the filter at some distance below the surface would be practically uniform. If we consider the particles of filtering material as perfect spheres and the sewage as a fluid which has no cohesion between its own particles and no adhesion for the filtering material, this theory is undoubtedly applicable. Practically, however, the conditions are quite different. So far as the writer is aware, the only published experiments which apply in this case are those made by Venable,* the results of which he states as follows:

> To determine the tendency of water to spread out laterally while descending through sand, two plates of glass were mounted in vertical planes a half inch apart and the space filled with sand. Water was then poured upon the top edge or surface in places, and its descent against the glass observed. The water fell with great rapidity in all cases, even where very fine sand was used. It descended freely at a uniform rate of from a foot a minute to a foot or more per second, depending upon the fineness of the sand and independent of the size of the dose. There is little or no tendency for the water so descending to spread out laterally. It descends as a body. The water leaves the sand moister after the passage of the main volume or dose, and thus the dose becomes smaller as it descends, while the moisture left behind seeps more slowly to the bottom through the interstices which it only partially fills.

Investigations to determine the distributing effect of different kinds and different depths of material commonly used in trickling filters are in progress at the Experiment Station at the present time. In these investigations one-half of the adjustable platform in the testing apparatus has been removed and a trough, with an open bottom covered with wire netting, filled with filtering material has been substituted. One of the sprinklers previously described is placed at the one end of this trough and operated as usual, the discharge upon one radius of the circle being caught in funnels set at the same elevation as the top of the material, the discharge upon the opposite radius falling upon the surface of the material, through which it trickles naturally as it would in a filter and is collected by tunnels placed below. Averages of a number of consecutive runs, with the sprinkler rotated through various angles, are made to eliminate the error of unequal discharge upon different radii, and the filtering material is allowed to drain thoroughly after each run. The experiments, so far as they have proceeded, confirm those made by Venable with sand. In no case has any tendency of the water to spread within the filter been noted. In fact, the reverse appears to be true at times, as in the case where there is a large discharge upon one ring and the discharge upon the adjacent rings relatively smaller, in which case the volume passing through the ring of maximum discharge and collected below is greater than at the surface and the volumes passing the adjacent rings are proportionately less. This effect is probably produced by the pooling of the water upon the surface or within the material, by the formation of channels in the material through which the large volumes pass rapidly and by the tendency of the water in the less wet areas to take the course of least resistance and flow toward these waterways. This effect is especially marked in measurements made within a short time after the water is applied to the surface and before the material has had time to drain completely and is observed in a lesser degree when complete draining has been allowed before measurements are made. These results indicate that we cannot expect the filtering material to perform the work of distribution which rightly belongs to the sprinklers, and further that the sprinklers must be operated in such a manner that excessively large volumes of sewage shall not be applied to any portion of the surface, otherwise considerable portions of the sewage will pass through the filter so rapidly that little purification can be accomplished. This, essentially, means uniform surface distribution; fine spray, and in the case of sprinklers with large orifices very short periods of intermittency in order to keep the volumes applied as small as possible.

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*Venable, Bacterial Treatment of Sewage, New York, 1908, page 143.

PRACTICAL CONSIDERATIONS.

In the data previously recorded all results are stated in terms of the portion of the filter surface actually covered by the sprinkler, and no corrections have been applied for the areas between circles when a number of sprinklers are placed on large areas nor for the surface adjacent to the sprinkler itself, which is frequently overthrown and receives no sewage. With sprinklers as centers of squares no sprinkler throwing a circular spray can cover more than 78% of the surface, that being the ratio of the square to the inscribed circle. The more logical method of placing sprinklers, and the one generally used by engineers, is as centers of hexagons which fit into one another honeycomb fashion. The circle covers nearly 91% of the circumscribed hexagon, as against 78% of the square, and a correspondingly greater amount of the filter bed is brought into use. If the nozzles be so spaced that the circles overlap one-thirteenth of their diameters all of the filter surface is wet and does some work. The size of the filtration areas has some influence upon the proportion of the surface brought into use, as with any arrangement of interlocking hexagons there are certain spaces on the outside edges of the areas which will not be covered. With small areas, containing from 20 to 100 sprinklers, the actual area wet when the circles do not overlap is from 80 to 85% of the total area, while with large areas containing 400 or more srinklers 90% of the filtration surface is covered by the circles. An increase in the number of sprinklers above 400 has little effect upon the proportion of the surface covered, nor does the shape of the filtration field, except in cases of small installations, affect this proportion to any appreciable extent.

The results of the tests made at the Massachusetts Institute of Technology were all corrected to allow for the sprinklers to be placed at the centers of squares, and to allow for the sprinklers being placed such a distance apart that the net rate on the entire filtration area should be 2.0 million gallons per acre daily. The correction for the placing of the sprinklers at the centers of squares had little effect upon the general value of the results, since they were all reduced proportionately. The wide spacing to obtain a low net rate upon the whole area with sprinklers of large discharging capacity seems to be entirely irrational, as by such spacing very large areas of filter surface would have to be constructed which would never receive any sewage and would, consequently, be entirely useless, while an actual decrease in the purification effected by the area would result, since the areas actually wet would be operated at a rate far above what appears to be the practical limit for filters of this type.

Too little attention appears to have been given to the intermittent operation of sprinkling filters, although this appears to be the logical method of keeping the rate upon the wet area down to a practical amount. For example, the Columbus 90° sprinkler under 5 ft. head, with the nozzle on the surface of the filter, covers a circle 13 ft. in diameter; and if operated continuously, sewage would be applied at the rate of 5.8 million gallons per acre daily. Spaced with wet circles touching, the actual rate of filtration based on the area wet would be approximately 2.0 million gallons per acre daily if the sprinkler were operated one-third of the time, and only 10 to 15% of extra filter surface would need to be constructed in addition to that actually in use as a filter. On the other hand, if the sprinklers were spaced wide to allow for a net rate of 2.0 million gallons per acre on the whole area, the nozzle would be operated continuously, one-third of the surface would receive all the sewage and be operated at approximately a 6.0 million rate, while two-thirds of the surface would always remain idle. Manifestly, it would be more economical to install more nozzles and operate some intermitting device than to construct large areas of filter which would never be used. The primary objection to intermittency appears to be the belief that the sprinkler nozzles will freeze in cold weather unless the flow is kept constant. That this objection is not valid is shown by the operation of the experimental filter at Andover* during the winter of 1906-1907, when, with intermittent operation in which no flow was maintained for periods of about four minutes, and temperatures below 0° F. for more than a week, running as low as 29° below 0° F. on one occasion, no trouble was experienced with freezing. From the results of percolation tests it appears that very frequent intermittency is desirable, in which case danger of freezing would be very much reduced.

The application of sewage to those portions of the filter adjacent to the nozzles, which are overthrown when they are operated under constant head, deserves special attention, since this is a part of the area to which the sprinkler is tributary and which it should be made to cover. The different sprinklers vary with regard to this defect, the two Salford sprinklers wetting all the surface within the radius of discharge more or less, while the Birmingham and the three Columbus sprinklers overthrew circles from 4 to 6 ft. in diameter when operated under the higher heads. By varying the head through a greater or less amount this overthrown area may be wet; but with the method of varying the head usually employed, that is by allowing the level of sewage to gradually fall in a tank of uniform cross section, the distribution is made much less uniform, since the ring of maximum wetting is drawn closer by such procedure. The use of a conical dosing tank has been suggested to remedy this defect, and there is no doubt that a dosing tank could be so designed as to make the distribution practically uniform on that portion of the surface inside the ring of maximum discharge at constant head.

It appears to the writer that both the wetting of the overthrown area and the uniformity of distribution might better be controlled by a differential valve located on the main supply pipe to the sprinklers. Such a valve could be made either as a rotary drum or disk with graduated orifices, or it could be made to open and shut by a cam, in either case being so designed that the flow of sewage would be varied proportionately to the volume required to be discharged upon the different rings of the circle to which the sprinkler is tributary. Given the rate of discharge by any type of sprinkler at different heads, and the volumes discharged upon the different concentric rings at each of those heads, the design of a cam for an open and shut gate, or of the size and shape of the ports in a rotary valve, in order to get a practically uniform distribution on that portion of the surface inside of the ring of maximum wetting at the greatest available head, is comparatively simple. Experiments with hand operation of the valve on the sprinkler testing apparatus show that such a method is entirely feasible. In large installations one valve could be used to control the operation of all the sprinklers; the power required to operate such a valve would be very small, and the cost of operation would be more than offset by the saving in filtration area necessary and by the better purification resulting from a more even distribution.

The flooding of the unused portions of the filter lying between circles, and the increasing of the uniformity of distribution upon the areas lying outside the ring of maximum discharge, appears also to be entirely feasible by simply overlapping the wet areas in such a manner as to obtain the greatest uniformity. In this case we cannot hope to approach absolute uniformity of distribution, as is theoretically possible on the inner rings by the use of a controlling valve; but we may approximate uniformity very closely.

The distribution by a system of Columbus 120° sprinklers, spaced with overlapping sprays, and with a rate controller designed as above stated, has been computed as an illustration of these principles. With the nozzle on the surface, this sprinkler was operated at 2, 3, 4, 5, 6, 7 and 8 ft. constant head, and the [illegible] upon the various concentric rings and the rate of flow at each head were determined. With sprinklers set 12 ft. apart as centers of interlocking hexagons, the areas wet by the different sprinklers overlap, each hexagon receiving sewage from the sprinkler located at its center, and from six other sprinklers located at the centers of the adjacent hexagons. If the flow to the sprinklers be controlled by a differential valve with ports of such size that the sewage shall be discharged from the nozzles at rates equivalent to the discharge under a 2, 3, 4, 5, 6, 7 and 8-ft. head for one unit of time, respectively, the distribution upon the hexagonal area becomes somewhat as follows: There is an inner zone comprising 8% of the area of the hexagon to which sewage is applied at less than 50% of the mean rate for the whole area. Surrounding this is another zone covering 9% of the total area to which the sewage is applied at between 50 and 75% of the mean rate. To the remaining 83% of the surface sewage is applied at a rate of not less than 75% and not more than 135% of the mean rate. Expressing the results in the same manner as that previously used, 72% of the sewage is applied to 61% of the surface; the coefficient of uniformity is 0.89 and the coefficient of efficiency is 1.81. If data concerning the distribution by this type of sprinkler at heads less than 2 ft. had been available, the distribution upon the inner rings could undoubtedly have been made much more uniform, and our coefficients of uniformity and of efficiency would have been correspondingly increased. If the sprinklers were operated continuously the mean rate on the hexagonal area would be 5.2 million gallons per acre daily. Operated intermittently with a controller so designed that the sprinklers would discharge 38% of the time, the mean rate would be 2.0 million gallons per acre daily, and the maximum rate on any portion of the surface would be 2.7 million gallons, or with a design permitting a discharge during only 28% of the time, the maximum rate would be kept down to 2.0 million gallons per acre daily, and the mean rate would be about 1.5 million gallons.

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[*] See Eng. News, April 11, 1907, page 399.

THE DECOMPOSITION AND LIQUEFACTION EFfected by septic tanks has been studied by Dr. W. Favre, of Khorkov, Russia, who has had the advantage of working with Dr. Dunbar, in the Hygienic Institute of Hamburg, Germany. The following summary of Dr. Favre's studies is from London "Engineering" for July 17, 1908:

Some Russian engineers had thought to get over all the sewage trouble simply by building huge septic tanks; Dzierzgowski on the other hand considered that the septic tanks at Zarskoe-Selo near St. Petersburg were doing very little good. Favre therefore made further experiments on the rate of the decomposition and liquefaction of different substances in the septic tank, in the stagnant effluent drawn from it, and in the flowing water of the ordinary supply mains. The substances which he investigated were albuminoids—i. e., boiled white of eggs; meat, raw and boiled; whole pigeons, plucked and with their feathers; fish, raw and boiled; further, cartilage, sinews, leather, feathers, wool; fats, butter, tallow, and the yolk of egg; and carbohydrates, such as potatoes and cabbages, raw and cooked; linen, hemp, string, paper, and cork. That the yolk of egg is classed with the fats, and not with the albuminoids, is in accordance with the usual practice; the yolk contains about 29% of fat and 15% of albumen. The experiments were conducted at ordinary temperature, and the supply water was hence naturally colder than the other media. The albumen was completely dissolved in the septic tank within six weeks; in the effluent it was only discolored; in the water it turned slimy, but otherwise remained fresh. Meat, especially when boiled, disappeared in the septic tank, but underwent a much slower change in the effluent and in water; the fat in the meat resisted longest. More or less the same observations were made in the other cases. The septic tank destroyed everything, or deprived the leather, wool, feathers, string, and linen, at any rate, of their strength; fish decayed faster than meat, butter resisted putrefaction a very long while, except at the surface; only the vegetables were almost as quickly decomposed by the effluent as by the septic sludge; enzymes are concerned in this instance. The experiments confirm, on the whole, those of Dunbar and his assistants, and bring out the hardly surprising fact that a stagnant effluent does not favor rapid decomposition. The action commences, but does not proceed far, because the putrefaction kills the active organisms in the stagnant liquid, while in the septic tank the sludge is renewed at certain intervals. The lesson to be drawn is that septic tanks of many days' capacity are a mistake; prolonged stagnation is not profitable. For the same reason corners and spaces in septic tanks in which the stuff is likely to stagnate should be avoided—a point which deserves attention with regard to the disposition of the valves and conduits.

A CHIMNEY OF CONCRETE BLOCKS BUILT WITHOUT THE USE OF SCAFFOLDING.

We illustrate herewith a novel system of chimney construction which has been invented by a Belgian engineer, M. Dumas, of Brussels. It has been covered by patents and is controlled by the firm of Léon Monnoyer et Fils, contractors, of Brussels.

While the chimney is constructed of concrete blocks, reinforcement is used with it, and there would appear to be no difficulty in proportioning this reinforcement to the stresses to be sustained. It may be noted, also, that the vertical reinforcing rods are so placed as to be much less exposed to the interior heat than is ordinarily the case. The blocks are of large size, permitting rapid construction, and the provision for securing the taper in the chimney construction is particularly ingenious. The chimney is polygonal in cross-section, and may be built with 6, 8, 10, 12 or more sides, according to the size of the structure.

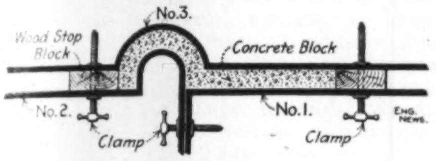


Fig. 1. Plan of Mold for Concrete Blocks for Chimney Construction.

The casting of the concrete blocks is illustrated in Fig. 1, which shows a cross-section of the block in the mold. As seen in the drawing, the cast-iron sides of the mold are in three pieces, only, and the ends of the mold are formed by wooden stop-blocks. By adjusting the position of these stop-blocks, the length of the concrete block can be altered to suit the course in which it is placed; thus the taper of the chimney is secured without multiplying the number of molds.

Fig. 2, which shows a partial cross-section of the chimney, will illustrate how, by varying the lap of the shank of the block past the semicircular lip of the adjacent block, the diameter of the circle is drawn in at each successive course. It should be understood that the blocks are reversed in direction in each successive course, so that the joints are properly broken. The largest blocks used are nearly 3 ft. in length, and the distance across the semicircular opening is 6 to 8 ins.

The vertical reinforcing rods are placed in the semicircular openings and may be seen projecting in Fig. 3, which shows the chimney in process of erection. It will be noted in that view, also, that the hoisting of the blocks is done from the interior of the chimney. To provide for circumferential reinforcement, there is placed on the bottom board on which the blocks are molded a wooden strip of triangular cross-section. This leaves a V-shaped groove in the block, in which a rod or wire may be placed for reinforcement. The blocks are usually about 10 ins. in height and the thickness varies from 6 ins. for the bottom courses of the chimney to about 3 ins. near the top. Rods are molded in the blocks, in the chimneys hitherto built, for convenience in handling them.

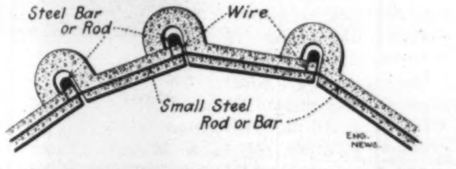


Fig. 2. Partial Cross-Section of Chimney Built with Concrete Blocks.

The molding of the blocks is done at the site of the chimney, and they can be properly seasoned before the erection is begun. As the blocks are solid, there is no difficulty with cores, and there should be no trouble in securing a high-grade of concrete. In practice, the molding of the blocks is carried on while the foundations for the chimney are being prepared. If the temperature of the chimney gases requires it, firebrick lining can be placed inside the chimney as it is built up, in the usual manner.

The large size of the blocks, and the fact that they are erected without scaffolding, enables the chimney to be constructed with a small working force and with great rapidity. It is claimed, also, that the cost of these chimneys is less than that of chimneys made in any other way.

We are indebted to Mr. H. Prime Kieffer, of Berlin, Germany, for the information regarding this new system of chimney construction from which the above article has been prepared.

A SUGGESTION FOR NEW SYMBOLS FOR REPRESENTING PHYSICAL QUANTITIES.

The multiplicity of physical quantities which enter into the current formulas and analyses of physical and technical science has long outgrown the limits of a single alphabet. Most writers, therefore, resort to two alphabets, as the Latin and the Greek; some even employ a third, as the German. It might be thought that this would wipe out the difficulty and furnish an excess of characters to provide for growing needs. But this is not the case; few writers in engineering theory or in physical analysis succeed in marshaling their quantities and equations without experiencing frequent embarrassment from want of characters to represent their quantities.

A radical suggestion to relieve the situation, by freeing us from the restrictions of alphabets, is now put forward by a committee of the British Electrotechnical Commission. They propose to create new characters for the principal quantities dealt with. The scheme is interesting by its novelty alone, if by nothing else. The faith of the originators is attested by the fact that they have gone to the extent of making some specimen type to illustrate the plan.

The following circular letter of Mr. Miles Walker, M. Inst. E. E., written at the instigation of the Subcommittee on Symbols of the British Electrotechnical Commission, outlines the plan clearly:

It is very desirable to have a notation for the representation of physical quantities in scientific books and periodicals which shall be the same in all languages. The subject is under the consideration of the International Electrotechnical Commission with a view to international agreement, and committees in the different countries (in England under the Chairmanship of Lord Rayleigh O. M.) are discussing this particular subject. They are dealing more especially with symbols for electrical and magnetic quantities, but the system might with advantage be extended to embrace all important quantities in physical science, especially as the subject is receiving the attention of most technical societies with a view to some action being taken in the matter.

There are, however, two great difficulties which arise when we try to fix upon a standard notation.

The first is the difficulty of persuading a number of writers and readers who have become accustomed to a certain symbol for a certain quantity to change it in favor of an equally large number of writers and readers who have become accustomed to another symbol. For instance, in France and Germany, the letter "I" commonly represents the strength of an electric current, while in England and America "C" is more commonly used. [In America I and i are now very generally if not universally used for current strength.—Ed.]

In the second place, there are not enough letters in the two or three alphabets at our disposal to give a distinct symbol to each quantity, without resorting to the combination of more than one letter to form a single symbol. There is a great objection to this combination of letters, because the use of subscript letters and numbers is required for distinguishing between particular quantities of the same general kind. If, for instance, C represents current, C_a might conveniently represent armature current, and C_1 the current in circuit No. 1. It would therefore not be good to take C_a to represent capacity, or any other quantity other than an electric current.

There is, moreover, an objection to using letters at all to represent quantities in a universal notation, because, unless initial letters are used, there is no connection in the mind between the letter and the quantity, and the symbol is difficult to remember. We cannot always use initials, because the initial letters differ in different languages. For instance, in England "R" commonly stands for resistance, while in Germany it is more convenient to use "W," for "Widerstand." Moreover, the same initial occurs for a great number of different quantities. For instance, "R" might stand for Resistance, Reluctance, Reactance, Radius, etc.

One way of avoiding the above difficulties would be to create a number of new symbols which could be printed by means of type like ordinary letters, and which would represent each physical quantity in a distinctive manner.

The question, however, arises as to whether a number of entirely new symbols would be acceptable to writers, readers and printers alike, and the Subcommittee on Symbols appointed by the British section of the Commission has requested the writer to place his views publicly before the profession with a view of obtaining suggestions and criticisms as to the feasibility of such a scheme from as wide a circle as possible.

In choosing a symbol, we would try to make a very simple picture of something that reminds us of the quantity in question. For instance, | might represent temperature. If we were told that this simple outline of a thermometer represents temperature, we would have no difficulty in remembering it. Similarly, / might represent force, and the various "forces" might be derived from it; for instance, ϟ electromotive force (conventional representation of lightning); and ∩ magnetomotive force.

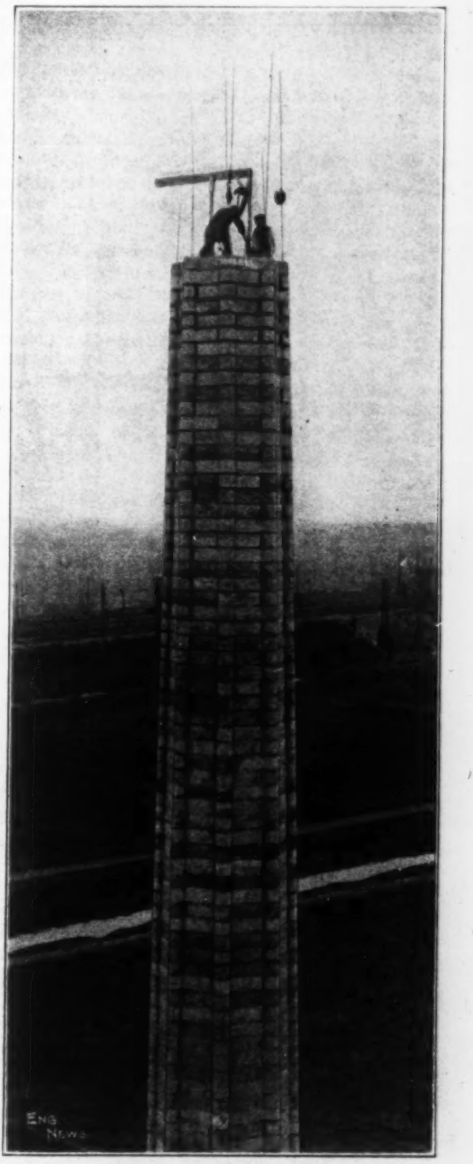


Fig. 3. View of Concrete Block Chimney Under Construction.

It is not my purpose here to say what would actually be the best form of symbol for each quantity, but it is not a difficult matter to devise very simple characters which can be written quickly, easily and with sufficient accuracy, and which can at the same time assist the memory to connect them with the quantity for which they stand.

What would the printers say to the new type? The author has taken up this matter with a very large publishing firm, and is assured by their chief expert that 200 or 300 new type would be a small matter to a modern printer, who is already accustomed to deal with many hundreds of different fonts, each of which contains from 30 to 120 different symbols. He estimates that a printer in a large way of business has at his command as many as 60,000 distinct type, differing from each other either in letter, size, body or face. The addition of 200 or 300 more would be a drop in the ocean. The size of the new type could be standardized for most purposes, and it would only be in some special case that another size would be called for.

The setting up of the formulas with the standard size of type would be simpler than with the present system, in which sub-script letters are often unnecessarily introduced. One symbol under the present system sometimes consists of 4 or 5 letters.

If it be admitted that the introduction of new symbols is advisable, the question arises what shall the new symbols represent exactly? Shall the sign 🌡 (temperature) represent temperature in any units, or shall it represent the number of degrees of temperature, measured by some scale agreed upon, and embodied in the definition of the symbol. If the system of units employed be not prescribed, fewer symbols would be required, and the general writer who now says vaguely "Let T equal the temperature," would find the symbol sufficient for his purpose. But from the readers' point of view there is much to say in favor of a symbol which will embody in its definition a standard system of units. Any formula expressed in such symbols would be completely self-contained, and would be an exact statement of a physical fact. Until the units employed in any formula are known, the formula expresses only half its meaning. Perhaps some slight addition to the symbol, or even to the whole formula, might be used to indicate that the standard system of units is employed. Without that addition, the symbol would have a general meaning. For instance, 🌡 might equal temperature, while 🌡 might indicate the degrees centigrade above the absolute zero.

The name of the type might be the name of the physical units which it represents; for instance, for ϟ we might read "*volts.*"

If writers, printers and readers, who have any definite views as to the best method of devising a system of symbols would communicate with the technical press, or with the author, they might assist in solving the many difficulties which arise in connection with this matter.

Miles Walker.

The Cottage, Leicester Road, Hale, Altrincham, England.

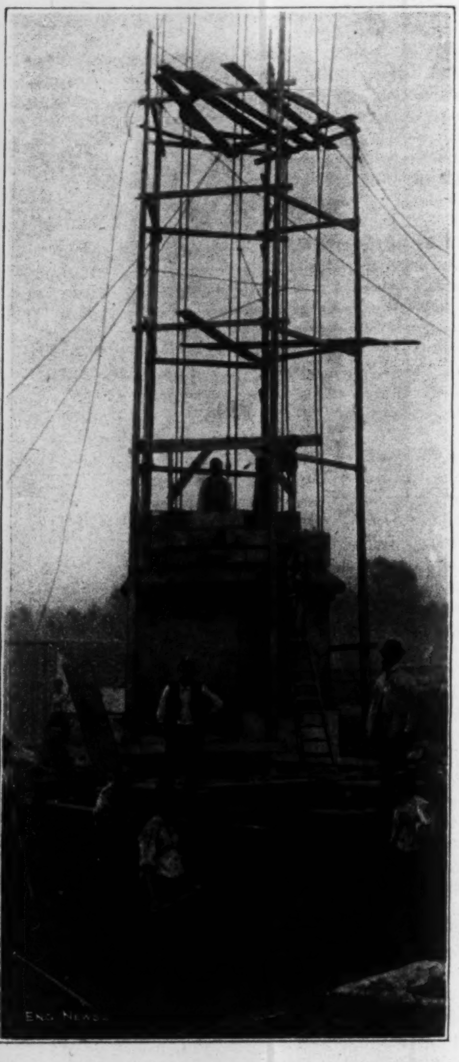


Fig. 4. Base of Concrete Block Chimney Starting First Courses of Blocks.

The above does not touch upon the question of how many different characters are to be originated. It is not easy to see a natural limit to the number which would be created. But it is clear that the proposal contemplates their formulation by a central body of strong authority, which would tend to prevent the gradual increase of their numbers.

The requirements of typography would make it extremely inconvenient to get along with a single size of body for the new characters, and it would be virtually essential for printers of technical journals or books to keep them on hand in all the common sizes of type.

◆

TESTS ON OIL-ENGINE PUMPING PLANTS AT WRENTHAM AND WAREHAM, MASS.

THE WRENTHAM PLANT.—The town of Wrentham, Mass., during 1907, installed a water-supply system for domestic consumption and fire protection. The plant comprises 5.64 miles of 6, 8 and 10-in. cast-iron mains and 0.32 miles of 2-in. There is a steel stand-pipe, 30 ft. in diameter by 50 ft. in height and an oil-fuel pumping plant nearby. The entire works cost about $50,000. The supply source is from 2½-in. tubular wells which tap a sandy, water-bearing, gravel stratum. The contiguous drainage area is such that the entire group of wells flows naturally when uncapped 1 ft. from the ground. The water is exceptionally fine and the drainage area is practically free from any form of pollution.

The pumping station has but one room, 25 × 36 ft. inside. The elevation of the floor is about 5 ft. below ground level, so that the well water nearly floods the suction chamber of the pump. But a single unit is now in position, although the second will shortly be in place. The equipment consists of a 25-HP., 12 × 12-in., two-stroke cycle, horizontal, crude-oil engine (Mietz & Weiss), with a fuel oil tank and air compressor for starting. To this engine is geared an 8 × 10-in. Smith-Vaile pump, having an actual capacity in ordinary use of 250 U. S. gals. per min. at 90 r. p. m., against 130 lbs. per sq. in. A careful 6-hr. test was made on Wednesday, March 4, 1908, under normal daily conditions of pumping. Ordinary fuel oil was used, weighing 7.5 lbs. per gal. and costing approximately 5.75 cts. per gal. delivered at the pumping station 1.5 mi. from the freight station.

THE WAREHAM PLANT.—In 1907 the Wareham Fire District installed a water-works system for domestic consumption and fire protection. The works comprises 5.4 miles of 6, 8 and 10-in. cast-iron mains, 34 fire hydrants, a steel stand-pipe 20 ft. in diameter by 100 ft. high and a double-unit oil-fuel-engine pumping plant in the village of Tihonet. The source of supply is from 2½-in. tubular wells which tap a water-bearing gravel stratum. The combined yield of six wells during a steam-pumping test covering 85.5 continuous hours was at the rate of 315,000 gals. per day. The present daily consumption, 40,000 gals., is not expected to reach a figure of 100,000 gals. for many years. The stand-pipe contains, when full, 235,000 gals., a 6-day supply at present. The pumping station building is almost exactly like that in Wrentham.

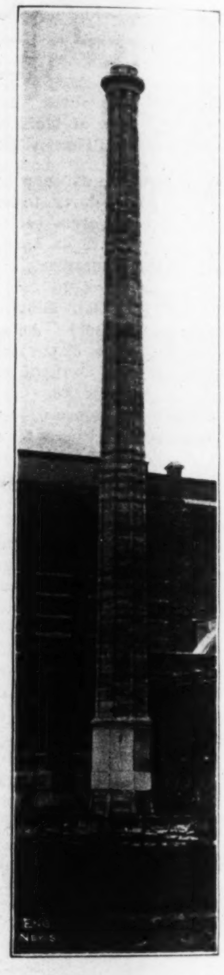


Fig. 5. View of Completed Chimney.

The pumping outfit consists of duplicate 25-HP., 12 × 12-in., two-stroke cycle, horizontal, crude-oil engines (Mietz & Weiss). These are

TABLE I.—SUMMARY OF TEST ON OIL FUEL PUMPING PLANTS. WRENTHAM AND WAREHAM, MASS.

	*Wrentham.	†Wareham.	
	Single unit.	North unit.	South unit
Length test, hours	6	3.5	[illegible]
Total No. revolutions	14,616	8,460	[illegible]
Average r.p.m.	40.6	40.3	[illegible]
Average capacity pump gals. per min.	262.28	260.34	[illegible]
Total gals. pumped	94,419.36	54,651.6	[illegible]
Lbs. per cu. ft. at 48° and 49° F	62.41	62.40	[illegible]
Average pressure, lbs. per sq. in., pumped against	77.625	102.0	[illegible]
Average vacuum, ins.	13.2	10.9	[illegible]
Total equivalent height, corrected	197.88	249.86	[illegible]
Equivalent pressure for total height, lbs. per sq. in.	85.88	108.44	[illegible]
Total work: pump; ft. lbs.	155,888,912	113,915,544	[illegible]
Average pump HP.	13.122	16.44	[illegible]
HP.-hrs. developed at pump	78.732	57.54	[illegible]
Total lbs. fuel oil	153.25	98.0	[illegible]
Lbs. fuel oil per HP.-hr., based on HP. at pump end	1.95	1.70	[illegible]
Cost pumping 1,000 gals.; cents	2.06	1.67	[illegible]
Cost raising 1,000,000 gals. 1 ft.; cents	10.4	6.7	[illegible]

*Wrentham test made under normal conditions.
†Wareham test made with force-main stop gate throttled to increase work done by engine.

TABLE II.—RECORD OF PERFORMANCE. WAREHAM AND WRENTHAM, OIL-FUEL, PUMPING PLANTS. MAY, 1908.

	*Wrentham plant.	*Wareham plant.
Days operated	20	27
Days idle	11	4
Average pumping period	3 hrs., 34 mins.	2 hrs., 38 mins.
Total gals. pumped; basis of 1% slip	1,132,968	1,106,268
Population supplied	900	1,000
Average daily consumption, gals. per capita	41	36
Average per cent. of superintendent's and engineer's time at pumping sta. on basis of 9-hr. day, including Sundays	30.9	43.1
Gals. fuel for pumping	258	269
Gals. fuel for warming up	26	33
Gals. fuel chargeable to month	284	302
Cost of fuel oil	$17.04	$21.14
Gals. lubricating oil	3.0	4.3
Gals. cylinder oil	2.5	0.5
Average pressure, lbs. per sq. in., pumped against	88.7	64.5
Average ins. vacuum, suction main	12.6	10.2
Total equivalent height of lift, including correction for gage heights	221.76	162.52
Average gals. pumped per gal. fuel used in pumping alone	4,400	4,110
Average gals. pumped per gal. fuel, all uses	4,000	3,660
Average duty per 100 lbs. fuel for pumping alone	72,000,000	66,000,000
Average duty per 100 lbs. fuel, all uses	65,000,000	59,000,000
Average pump HP.	9.55	9.2

*Both plants operating under normal daily conditions.

connected to two 8 × 10-in., vertical, triplex pumps (Smith-Vaile). The pumps and engines are similar to those installed in the Wrentham plant. A test was made on both units on Tuesday, April 21, 1908. Ordinary fuel oil was used, weighing 7.5 lbs. per gal. and costing approximately 7 cts. per gal., delivered at the station.

Table I. shows a summary of the results of the tests, and Table II. gives a summary of the station performances for May, 1908, for both Wrentham and Wareham.

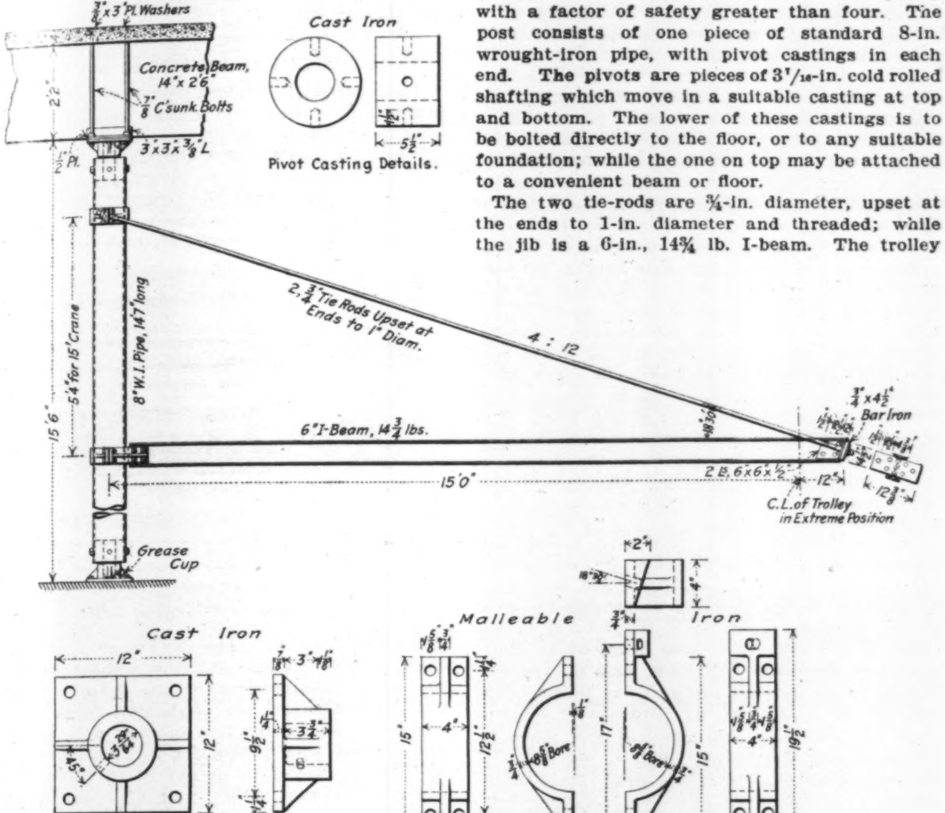
Both of these water-works were designed and installed under the supervision of Mr. Edmund M. Blake, C. E., No. 8 Beacon St., Boston Mass., to whom we are indebted for the data of the tests.

FIRE-KILLED TIMBER, of which large quantities exist in the Western States, is to be tested for strength in the new laboratory which the U. S. Forestry Service is now establishing at the University of Colorado, Boulder, Colo. Two testing machines are being installed, one of 200,000 lbs. capacity and the other of 30,000 lbs.

AN ADJUSTABLE JIB CRANE.

By A. L. CAMPBELL.*

The jib crane illustrated by the accompanying figure possesses some novel features not usually found in cranes of this class. Its chief claim to originality lies in the fact that the jib is adjustable vertically for a large portion of the length of the post. The crane is of 15-ft. radius, and 1-ton capacity with a factor of safety greater than four. The post consists of one piece of standard 8-in. wrought-iron pipe, with pivot castings in each end. The pivots are pieces of 3 7/16-in. cold rolled shafting which move in a suitable casting at top and bottom. The lower of these castings is to be bolted directly to the floor, or to any suitable foundation; while the one on top may be attached to a convenient beam or floor.



ELEVATION OF ADJUSTABLE JIB CRANE WITH DETAILS OF CLAMPS AND BASE-PLATE.

The two tie-rods are ¾-in. diameter, upset at the ends to 1-in. diameter and threaded; while the jib is a 6-in., 14¾ lb. I-beam. The trolley (not shown) is of the standard I-beam type such as is manufactured by several reputable firms. A chain-fall is attached to the trolley for lifting the load. Both the jib and the tie-rods are attached to the post by means of malleable iron castings which may be clamped on at any desired height.

This crane was built for use in a machine shop, where it is especially useful in serving one or more heavy machine tools. The height of the jib being adjustable, one design of crane is adaptable to different local conditions. The radius of the crane can also be varied by simply changing the length of the I-beam and of the tie-rods.

---

*401 Ferdinand Ave., Detroit, Mich.

A COMBINATION COAL LEVELER AND COKE PUSHER FOR BY-PRODUCT COKE OVENS.

Shortly after the first of this year, the Illinois Steel Co. placed a contract for coke pushers and coal levelers for a plant of Koppers by-product coke ovens being built at Joliet, Ill. There were to be three of these machines, two having sufficient capacity to take care of the requirements of the ovens, leaving the third as a spare unit. These machines have now been completed and shipped and a brief description of them is given for readers interested in such plants. Each machine consists of a coke pusher and a coal leveler carried on one traveling frame. Each is a duplicate of the others and all parts are interchangeable.

The main frame consists of four plate girders well fastened together. These girders rest on end trucks which are box-type steel castings of standard construction, so arranged that the track wheels may be easily removed. The thrust of the ram is taken up by two horizontal wheels bearing on the track. The shafts of these wheels are carried by the front truck casting. This construction does away with any strain in the flanges of the track wheels. The ram itself is a heavy box girder 61 ft. long. It is built of two 31 × ½-in. web plates, two 14 × 1-in. flange plates and four 6 × 3½ × 1-in flange angles. Each member is in one piece, there being no splices. To the bottom of the ram is attached a rack; a steel casting 14 ins. wide by 2½ ins. thick with shrouded teeth, 3-in. pitch 10-in. face. The sides of the ram are protected from the heat of the oven by removable asbestos shields. The front end of the ram is a steel casting 1½ ins. thick, provided with adjustable, side and bottom rolls. The ram rests on 14-in. flanged rolls and is traversed back and forth by a pinion driven, through a train of spur gears, by a 50-HP. motor.

The coal leveler consists of two bars 10 ins. deep, tapering to 2½ ins. deep at the front end. This "ladder" leveler is operated by an endless, plow-steel, wire rope which is attached to the rear end of the ladder, and is so arranged that it never enters the ovens. The rope is wrapped about a grooved drum which is connected to a 25-HP. motor by a train of spur gearing. The ladder may be run into the oven or withdrawn from it, and at any desired point an automatic vibrating arrangement can be brought into operation so that the ladder takes a stroke of 5 ft., backward and forwards, thereby leveling the coal. This motion is entirely automatic, under the control of the operator. The leveler and the ram are fitted with automatic switches for cutting out the electric current at the ends of their strokes, in both directions. The sets of gearing for the pusher ram and the leveler ladder are each mounted on an independent plate. These

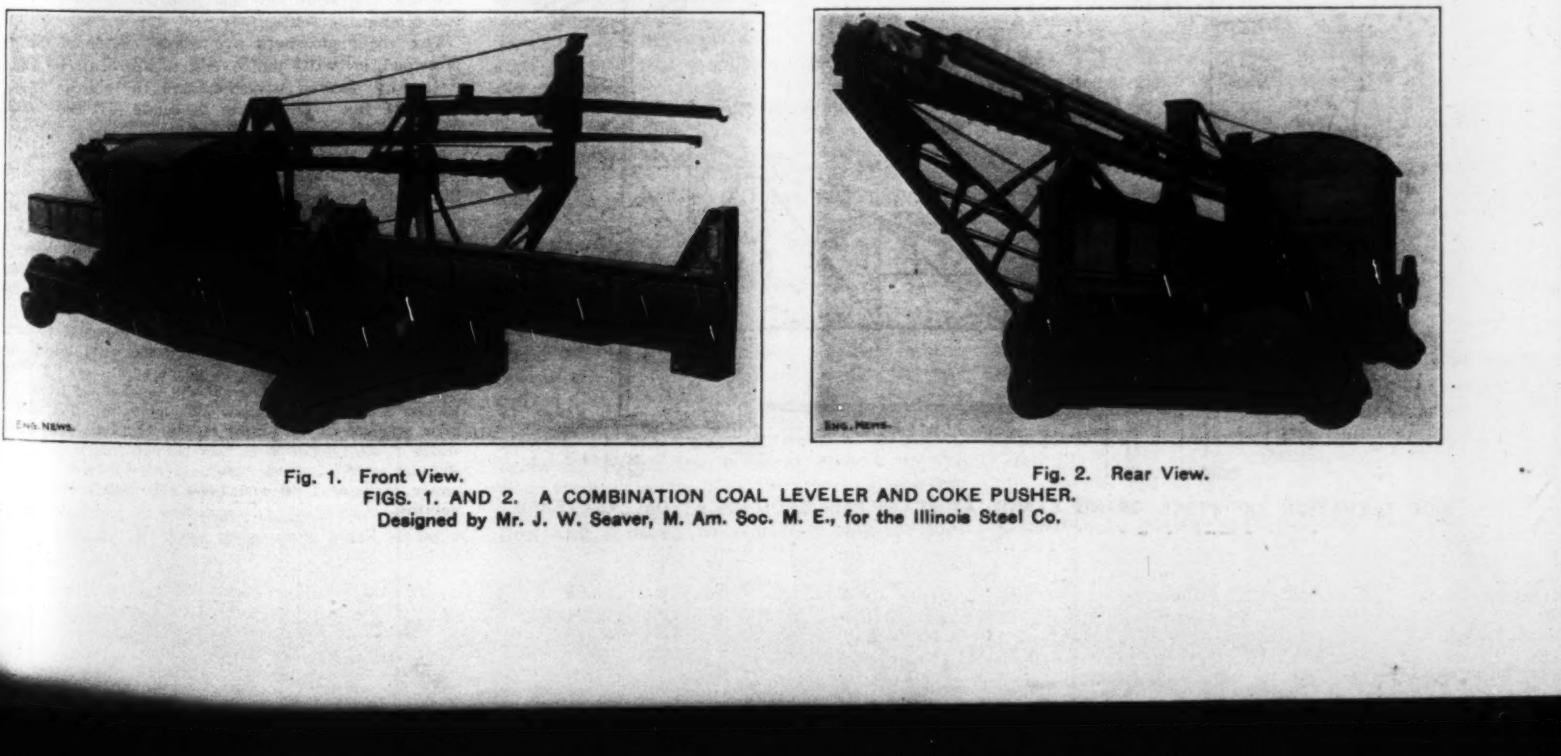


Fig. 1. Front View.

Fig. 2. Rear View.

FIGS. 1. AND 2. A COMBINATION COAL LEVELER AND COKE PUSHER.
Designed by Mr. J. W. Seaver, M. Am. Soc. M. E., for the Illinois Steel Co.

bed plates contain the bearings for the motors and the shafts, so that each set of mechanism is tied together and entirely independent of the framework, thereby preventing any getting out of line of the gearing. By lifting out the bed plates the entire sets of gearing are taken out. Located directly over the leveler ladder and worked from the operator's cab is an arrangement for the lifting and supporting the leveling doors which, in the Koppers ovens, are independent of the discharge doors. In the operator's cab is hand-traversing gear, so arranged that the operator can cut off the current from the traversing motors and adjust the position of the machine in front of the ovens by hand. A powerful foot brake is arranged to lock the machine on the track at any desired position. In the operator's cab there is placed a set of recording voltmeters and ammeters which shows the time of and the power taken by every stroke of the machine. The motors are series, mill type Crocker-Wheeler, one 50-HP. for the ram, one 25-HP. for the leveler, and two 25-HP. motors for propelling the machine along the track. It was aimed to make the construction of the machine of the most substantial type; the castings throughout are bronze or steel, no cast iron being used in the machine. Every part has a factor of safety of not less than six and the electric motors have an overload capacity of 50%. With the exception of the shrouded teeth, for the ram traverse, all of the gears have cut teeth. Over all the gears are placed plate-steel cases. In the designing of the machine special attention was paid to ease of inspection and removal in all parts.

Each machine is designed to operate at the following speeds:

Traverse on tracks	300 ft. per min.
Traverse of ram	80 ft. per min.
Traverse of leveller bar	120 ft. per min.

The machines were designed by Mr. J. W. Seaver, M. Am. Soc. M. E., Consulting Engineer, Cleveland, O., and were built by the Alliance Machine Co., Alliance, O.

A STEEL FRAME GRAND STAND AT DALLAS, TEXAS.

By HOWARD ARTHUR.*

The steel frame for the new stand at the race track of the Texas Fair Association, at Dallas, Tex., will be 64 ft. wide between outside columns and 300 ft. long. The framework consists of 16 roof and 16 seat trusses, carried on columns to concrete footing pedestals. The roof trusses are spaced 16 ft. c. to c. and rest at the rear on columns similarly spaced, and at the front on longitudinal trusses 6 ft. deep which are carried by columns 60 ft. c. to c. The seat trusses are spaced 16 ft. c. to c. and rest on four columns. Details of the design and structural makeup of the framework may be readily noted on the accompanying figure. Both gable ends of the roof are closed, having wood framing secured to upright beams spaced about 5 ft. c. to c., running from the top chord of the truss down to the level of the gutter, there to be secured to a horizontal truss 3 ft. deep, running transversely from column to column.

In the design, the dead-load of the seats, etc., coming on the seat truss was taken at 31 lbs. per sq. ft. and the live-load as one person weighing 170 lbs., with 50% additional impact, occupying a space of 1 ft. 6 ins. × 2 ft. 10½ ins.

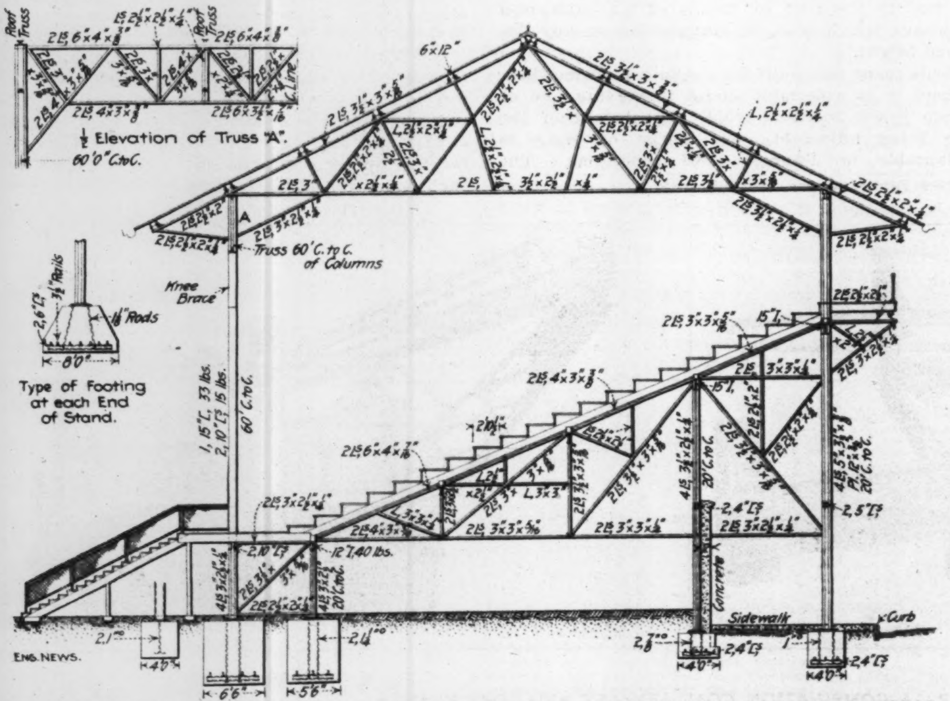
In a longitudinal direction the wind was assumed at 30 lbs. per sq. ft. on the near face of the near gable and at 45 lbs. per sq. ft. on the near face of the far gable, both acting simultaneously. This wind thrust is carried between trusses by the purlins and by diagonal bracing in the end and every fourth panel, thence to the rear columns, which are continuously counterbraced from end to end. The bracing in the bottom chord of the roof trusses is in every other panel as the right hand bottom chord is in compression two-thirds of its length when wind is underneath. In the seat trusses there is bracing in every other panel in the planes of both top and bottom chords. All rows of columns are counterbraced longitudinally in every panel.

The roof trusses are considered free at front and fixed at rear, and a wind load of 30 lbs. horizontal was figured from both right and left sides. In addition to this, in order to provide for wind from left when underneath, the strains in the truss from right wind were reversed in character and increased 50%. All wind on the roof is resisted by the rear columns and taken to the point of intersection of the third row of columns from front with the top chord of seat truss, by means of the inclined member in the plane of the top chord of seat truss and the diagonal member consisting of two 3½ × 3 × 5-16-in. angles running from that point to fourth row of columns. The horizontal wind force at the above intersection goes partly down the third row of columns and partly down the top chord of seat truss, and from there down to ground in first and second row of columns. In the above assumption the horizontal member in plane of bottom chord of seat truss connecting to the third and fourth row of columns is not considered as taking wind; it acts merely to stay the columns at that point.

The total cost of stand, including concrete wall 320 ft. long, plumbing, etc., was $40,000.

The design submitted by the Mosher Mfg. Co., of Dallas, was accepted by the Fair Association, and Messrs. C. A. Gill & Son were appointed architects. Mr. G. S. Bergendahl, consulting engineer, of St. Louis, represented the Fair Association. The construction was carried out by the Mosher Mfg. Co.

*Engineer, Mosher Mfg. Co., Dallas, Texas.



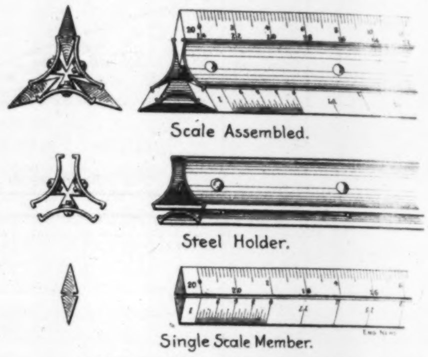
SIDE ELEVATION OF STEEL GRAND STAND AT STATE FAIR GROUNDS AT DALLAS, TEXAS.

* * *

A CONVERTIBLE TRIANGULAR SCALE.

The convertible triangular scale illustrated herewith is a new device that promises to appeal to progressive draftsmen.

The scale consists of a central core or holder, and three separate scale members. The holder consists of three light sheet-metal walls secured by screws to the center braces, spaced about 4 ins. apart along the length of the holder. These braces are of such shape as to hold the walls in their proper relative positions without interfering with the insertion of the scale members. The scale members are of rhombic cross-section, and every one of the four faces of each member is provided with graduations. The scales may be readily slipped in or out of the holder and reversed so that either pair of edges of any member is in position for use. By means of the adjustment screws, the scales may, if desired, be locked securely in position, or they may be allowed to slide easily in the holder. The angle of the scales is such that only their extreme edges come in contact with the drawing and the divided surfaces are protected from wear. This form, at the same time, provides an excellent angle of vision.


Scale Assembled.

Steel Holder.

Single Scale Member.

A Convertible Triangular Scale.

The compactness of the scale is evident. Although the equivalent of two triangular or twelve flat scales, it is held by a case but little larger than that required for the ordinary triangular scale. It possesses, too, the combined advantages of the best triangular and flat scales. If desired, all but one of the scale members may be removed from the holder, placing this scale in a class with the flat scales, and eliminating the possibility of error due to using the wrong graduation, which exists in the case of the triangular scale.

The scale members are made either of plain boxwood or with white edges, and can be had with any desired division, and in lengths from 6 to 24 ins. The scale is made by the Lutz Co., of Guttenberg, N. J.

* * *

ELECTRIC TRACTION ON THE LOETSCHBERG APPROACH.—The Bernese Alps Railway Co. has decided to instal electric traction between Spiez and Frutigen, on the northern approach to the Loetschberg Tunnel, and has appropriated $200,000 for the purpose. The experience on this section, it is expected, will be of value in deciding on the type of equipment and line-construction on the main part of the tunnel railway. According to the "Schweizerische Bauzeitung" it is intended to use 15-cycle, single-phase current at 15,000 volts line-pressure, this being computed to be cheapest both in first cost and in operation. Current will be obtained from the Kander & Hagneck hydraulic plant at Spiez. The maximum gradient on the tunnel railway is 2.7%. Passenger trains of 250 tons at 25 mi. per hr. and freight trains of 300 tons at 18 mi. per hr. are to be provided for. Motive-power units of 1,200 and 1,500 HP. will probably be required.

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The pitting of hydraulic turbine vanes described by a contributor in this issue is undoubtedly closely similar to the pitting of steamship propellers, which has long been a troublesome problem of the marine engineer. In both cases, the pitting not only makes necessary heavy expense for repairs and renewal of the parts, but seriously affects the efficiency. The extent to which a cast-iron propeller will be honeycombed by pitting in a comparatively short time is almost unbelievable.

In both cases the best preventive of the pitting appears to be the substitution of bronze in place of iron or steel. An additional advantage of the bronze blades is that its greater strength and resilience enables the use of thinner and better formed blades.

The cause of the pitting seems to be closely associated with the release of the air or other gases held in suspension or in solution in the water, and the smooth passage of the water past the blades without eddies or churning and consequent changes in the pressure upon the water, appears to cause the least pitting. From this point of view a turbine or screw of high mechanical efficiency will not only give the best results in work done, but will be the most durable.

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How to get the maximum amount of work from a given sewage filter bed of the percolating type depends largely upon the uniformity of the distribution of sewage over the bed, and that, in turn, depends on the character of the sprinkler employed. As we pointed out in an extended editorial discussion in our issue of Jan. 9, 1908, the efficient dosing of such a filter is not such a simple matter as it may seem to be. Confining our remarks to the fixed sprinklers of the nozzle or disk spray type, since these alone have met with favor in this country thus far, the problem is to get as large a percentage of the filtration area as possible sprinkled with sewage as uniformly as may be: that is, without unwetted, underwetted or overwetted areas. The nozzle and splatter-disk sprinklers wet circular areas. If these areas just touch, some of the filter receives no sewage and does not work; if they overlap, all the filter may be kept at work, but the overlapped portions at a higher rate than the others. In addition to these possible faults, the radial distribution of the spray from each nozzle is more or less unequal and there is a portion near the nozzle or disk which receives no sewage. All these faults may be remedied in some degree by variations in: (1) the design of the nozzle or disk; (2) the working head; (3) the spacing of the nozzles; (4) the arrangement of the nozzles in centers of squares or of hexagons; etc., etc.

Two important series of tests to determine the relative efficiency of nozzles and disks of varying shapes, as well as other factors involved, have been carried on in this country. One of these, by the Sanitary Research Laboratory of the Massachusetts Institute of Technology, we reported at length in our issue of Jan. 9, 1908, in the form of an abstract of a lengthy paper on the tests. In our present issue we are fortunate in being able to present a description and summary of results of tests carried on at the Lawrence Experiment Station of the Massachusetts State Board of Health. All who are called upon to design percolating sewage filters will do well to study the results of both series of tests with great care.

We take particular pleasure in calling attention to the tests reported in this issue because in our issue of Jan. 9, 1908, we commended the Institute workers for having taken up the study of mechanical devices in actual use, in contrast to the investigators at Lawrence. It now appears that the Lawrence workers are deserving of equal commendation in this regard.

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Can a large railway afford to run the chance of having its trains on an entire division tied up for three or four hours? This question was made much of in the early discussions of electric operation of railways, as an argument against "electrification." It is a very plausible argument: With steam locomotives every train is independent, and an accident can rarely interfere with more than one or two trains; with electric operation, however, everything depends on continuous supply of power from the generating station, and should an accident disable the station or interrupt the supply wires the whole railway or the whole division would be dead. The ready answer to this was that the power station is the most reliable part of the system, and with its duplication of machinery, etc., is far more safe against breakdown than the crude steam locomotive; and that it would prove easy to apply automatic cutouts and duplicate lines at every point to the effect of ensuring that no interruption need last more than a few seconds. The steady service of city lighting systems was referred to as a convincing argument in favor of the high degree of reliability of a large electric generating and supply system.

A breakdown of just the kind prophesied paralyzed the electric terminal division of the New York, New Haven & Hartford between New York City and Stamford, Conn., a few days ago. It is reported that a high-tension cable leading out from the power-house failed. The entire division is supplied from a single generating station. The result was to cut off current from the whole division for several hours. Trains could not enter or leave the division or move along in it except where a steam locomotive happened to be available. This was not the first such interruption; a similar though shorter one occurred a few weeks before. The two together reinforce each other as evidence of the reality of the chance of interruption.

The time has gone by when these interruptions could be made an argument against electric operation of railways. Electric equipment has proven able to meet all demands as to steadiness of operation, on lines whose nature and traffic are suited to the case. The New York Central, in fact, operating its electric terminal division in the same territory as the New Haven's, has been free from interruptions of any considerable duration, and there is no reason to suppose that other lines under electric operation would not be able to secure substantially equal reliability.

What the interruption does show is that it is highly necessary to design an electric supply system for railway operation in such a way as to protect at every single point against the chance of a general interruption. The principle of duplication, with full protection of the alternate sets of equipment so that the one cannot involve the other in difficulty, must be applied in thorough manner from boiler to track. All elements should be arranged to cut themselves out of the system automatically when damaged, and where this is not possible they must be arranged for prompt detection of trouble and quick disconnection. If a storage-battery reserve of power affords additional security, over and above that secured by mere duplication of transmission lines and generating plant, let it also be provided. Economy in first cost may not be allowed to weigh against the gain in certainty of continuous service.

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We print in this issue a review of the use of concrete as a material for street paving and the experience of various cities with it. As our readers know, concrete paving for alleys and driveways and to a limited extent for streets has been used to a considerable extent for some fifteen years or more. Within the last year or two, the promotion of concrete paving has been taken up as a business proposition. It is hardly necessary to say to our readers that the character of concrete work of all classes depends upon how it is executed. It is entirely reasonable to believe that a concern making a specialty of concrete paving, developing a staff of experienced workers and following rigid practice in the selection and assembly of materials and particularly in the preparation of the subgrade and the placing of the concrete, can produce results far superior to those possible with the ordinary contractor's concrete gang.

Admittedly, concrete paving has special advantages of its own. It is smooth like sheet asphalt and like that may be more easily kept clean than any other pavement. It is absolutely uninjured by water and is unaffected by temperature, two important advantages over asphalt. It is, therefore, ideal from the sanitary point of view. If pavements were to be chosen for automobile use alone, concrete would probably stand at the head. Again the base and wearing surface are monolithic; and there is not the difficulty with defective blocks which causes so much trouble in brick paving and gave such a black eye to the asphalt block pavement in its early days.

Again, concrete is—or ought to be—one of the cheapest of paving materials, at least in any region where good stone and good sand are locally obtainable. This will be particularly the case where concrete paving is done on a large scale, so that machine mixing and economic methods of handling materials can be adopted. Bearing in mind prevailing prices for the concrete base for other kinds of pavement, we do not see why a price of $1.25 per sq. yd. should not leave a good profit to the contractor, assuming of course that a large amount of work is to be done, and that good materials are available at low prices.

As to whether concrete or sheet asphalt or wooden block as laid in New York City would be the least slippery, we should suppose concrete would have some advantage if the wearing coat were made up with hard grit and grooved to give a hold for the calks of horseshoes. The noise from concrete is said to be about the same as from bricks. The pavement would be hard to cut into, if it were good concrete, yet concrete base is cut through all the time, and the difficulty in turning traffic on a repaired spot before the concrete has set hard might be overcome—with some disadvantage of obstruction—by dumping a pile of sand over the new concrete.

Admittedly the crucial question with concrete and one yet unsettled is how much wear it will stand. We were told by one engineer with large experience in paving work not long ago, that the reason why the concrete streets of some small Western cities show so little wear is that the horse droppings are allowed to accumulate on the surface and form a protecting cushion—which is sound mechanics, but not so nice from a sanitary point of view.

Of course enough is known of the relative hardness of the artificial stone formed by the setting of cement so that no one would seriously propose a concrete wearing surface for the streets of heaviest traffic. But there are very many miles of street where something better than macadam is demanded, especially since the dust-spreading automobile has created a universal nuisance. There are not so many materials available within the limits of permissible cost that concrete will be an unwelcome addition to the number; but assuredly, concrete to give good results in such a place must be the best that the skill and science of the engineer can produce.

* * *

DEVELOPMENTS IN RAILWAY TRACK DESIGN.

Railway track construction has remained practically unaltered since the invention of the tee-rail, in 1830. After the abandonment of the early cast-iron rails on stone blocks, or strap rails on wooden longitudinals, no further change was made, and subsequent advance was solely in perfecting the proportions and details. A narrow-gage light railway for logging or plantation purposes has identically the same type of track as a main-line railway carrying the heaviest and fastest traffic. In both we find the rolled steel tee-rail laid on wooden cross-ties in a bed of ballast, bolted splice-bars to connect the butting ends of the rails, and driven spikes—simply large nails—to secure the rail to the ties. The heavy-traffic railway is distinguished only by heavier rails, larger ties and better ballast.

The few detail modifications of this standard type merely mark the universality of its use. Thus, English railways make extensive use of a double-headed (but non-reversible) rail, supported in cast-iron chairs upon the ties. In many European countries screws take the place of driven spikes. More or less extensive use is made of steel ties and concrete ties in some countries. In Europe, also, there is some departure from the ordinary type of track in the limited (and decreasing use of steel longitudinal supports for the rails. But the general character of the track is unchanged by these variations.

The fact that nothing has been done towards introducing radical alteration in track design was pointed out in an editorial review of standards of track construction of American railways, in our issue of June 4, 1908. We there mentioned that only few experiments (of very limited extent) have been made with new designs of track, and that even these have not been made with any idea of their being followed up in practice. It may be interesting to review some of the designs which have been tried or suggested. Before doing so, we may mention the use of special designs of track for tunnels and underground railways (as discussed in our issues of Aug. 2 and Sept. 20, 1906). These, however, are without influence on the general situation, as they are designed for and used under conditions very different from those which obtain on ordinary railway track.

An important point for consideration in new track design is the fact that the present construction is inherently weak in carrying the rails on individual supports which have no uniformity of bearing on the foundation. It is quite impossible, in practice, to obtain uniform bearing under all the 3,000 independent supports—the ties—in a mile of track, or even the 18 to 20 supports in a single rail-length. In theory, each tie is a rigid pier, carrying the rail as a continuous girder. In practice, the ties are supports of varying and unknown stability, yielding unequally under load. This increases the effective span of the girder (or rail), so that the latter may be subjected to stresses considerably higher than it is designed or intended to carry. Any increase in the deflection of the rail, due to this yielding of its supports, is a decrease in the quality of the track considered as a structure for carrying rolling loads. And the yielding of the ties tends to increase as time goes on by the effect of the compression, settlement or disintegration of the ballast which forms the foundation material.

Two methods have been suggested for improving these conditions: (1) the use of very deep and stiff rails (perhaps 7 to 9 ins. high), which will distribute the load over a greater length of track and will not be affected by a slight yielding of individual tie supports, and (2) the use of a continuous longitudinal support for the ties or rails.

Two combinations of continuous steel longitudinal bearings with intermittent rail supports have been suggested in order to eliminate the difficulties incident to the independent supports. The plan proposed by Mr. J. W. Schaub, M. Am. Soc. C. E. (Eng. News, June 13, 1907), was to put a line of I-beams under each end of the row of ties. The beams would be embedded in ballast and connected by tie-rods. Individual ties could not get loose or low, and the load upon them would be distributed to the ballast both directly and by the I-beams. This plan was designed primarily to reduce the excessive stresses in rails, to which reference has been made. It would have the further advantage, however, of converting the track into a homogeneous structure.

A more elaborate plan, involving an entirely new type of track, has been devised by Mr. G. Lindenthal, M. Am. Soc. C. E. This, in a modified form, is in experimental use for about 1,000 ft. in a freight track on the Pennsylvania R. R. Under each rail is a steel longitudinal, built up of Z-bars and angles. Upon this are oak blocks and steel tie-plates, to which the rails are secured by screw spikes. At intervals there are wooden cross-ties, in place of the blocks, in order to maintain the gage. The original design (Eng. News, Nov. 30, 1905) provided for longitudinals composed of special bulb-angles, 6 × 8 ins., with cast steel chairs for the rails, and with steel tie-bars connecting the chairs. The cost of the track as built is said to have been equivalent to about $25,500 per mile. In a discussion on track development presented to the Western Society of Engineers by Mr. G. H. Blakely it is stated that the vertical movement of this track under slow freight trains is greater than that of the parallel track under fast passenger trains. This was taken to indicate that the track does not provide sufficient bearing surface on the ballast, and that the longitudinals have inadequate vertical stiffness for distributing the concentrated loads over a sufficient length of track. The track is purely experimental, however, and Mr. Blakely admitted that the design might be so improved as to obviate these particular objections.

The use of a concrete roadbed has been suggested many times. The plans may be divided into two classes: (1) a concrete beam or longitudinal under each rail; (2) a concrete floor carrying both rails. The longitudinals would be laid upon a bed of crushed stone or clean gravel, and have earth filled in around them to prevent frost from penetrating the roadbed beneath the beams. The rails may be laid directly upon the longitudinals (and connected by tie-rods), or upon longitudinal I-beams anchored to the concrete and connected by transverse beams framed between them. The cost for this latter system has been estimated at $25,000 per mile. In either case, any necessary surfacing would be effected by jacking up the beams and tamping beneath them. A concrete floor system proposed by Mr. J. W. Schaub provides a continuous reinforced-concrete slab about 10 ft. wide, 8 ins. thick at the sides and 14 ins. at the middle. Longitudinal timbers would rest upon the thinner parts and against the thicker part, being held in place by horizontal through bolts. Ordinary rails would be used, with steel tie-plates and screw spikes. The slab would rest upon a bed of rubble concrete. The cost has been estimated at $14,000 per mile, exclusive of the rails.

The possibility of maintaining track in proper condition with a concrete floor construction on ordinary roadbed is open to very serious question. Its use for street and underground railways is no criterion, since in that case the sub-grade is not subject to the disturbing and erosive influences of rain, wind, frost and storm. On ordinary railways the rain washes the side slopes and penetrates the roadbed to a varying extent, frost is liable to penetrate and heave the roadbed, and in places the embankments continue to setttle for an indefinite period. It is true that embankments could be built more solidly, as for example by following methods of practice employed in the construction of dams and levees. But though this may be true in theory, it would not solve the difficulty for existing lines, and as concerns the future, railways will undoubtedly continue to be built as they have been and are being built, so far as methods of construction are concerned.

A survey of what has been done in designing or experimenting with new types of track construction affords little encouragement for the improvement of railway track by any radical change in design. In a discussion of Mr. Schaub's proposed concrete floor system, mentioned above, Mr. H. J. Slifer, M. Am. Soc. C. E., expressed the opinion that the present type of track will have to be abandoned in favor of one which will be of greater first cost, but will be much less expensive for maintenance. He also considered that such development would be along the line of affording a continuous longitudinal support. But as a matter of fact there is not the slightest prospect of the practical introduction of any change in the type of track construction. Even the experiments in this direction are so few and of such limited extent as to be entirely negligible. There is really nothing but the present universal type of track construction to be considered by the railway engineer or the engineer of maintenance-of-way.

This by no means implies that no improvement in track construction is to be looked for. It does imply that such improvement is to be looked for in the details of track of the present type, both in the individual design of the details and in the proportioning of the track structure as a whole. We lay stress upon the latter because railway track as a unit, as a complete structure, designed for the purpose of carrying certain loads in the form of moving trains, has in the past received very little attention. Each part is considered separately, and not in relation to the other component parts of the structure. For example, there have been numerous investigations as to rails, ties, joints, the holding power of spikes, etc., but very little special study has been devoted to the track as a unit structure.

It is obvious that the track structure should be designed with a view to the loads which it is to carry, but it is safe to say that no actual track is thus designed. The matters which are ignored include the loads and their distribution, the stresses in the rails, the bearing area afforded by the ties and ballast, and the relation of bearing area to weight of train and stresses in track. In a paper on stresses in railway track (Eng. News, Feb. 14, 1907,) Mr. O. E. Selby stated that while the fiber stress in Bessemer steel rails should not exceed 15,000 lbs., it may reach 18,750 lbs. on existing track. To quote Mr. Selby:

> Railway track has grown in strength as heavier loads have made increased strength necessary. But such growth has been entirely along empirical lines, and not one single detail of track superstructure bears marks of engineering design.

For new lines, the weight of rails, size and spacing of ties, depth and character of ballast, etc., are very rarely adopted on any basis of motive-power equipment or traffic conditions. As concerns existing roads, it is a very evident fact that in many cases the track has not been strengthened or improved in due proportion to the increase in service imposed upon it by the heavier loads, the higher speeds, and the denser traffic. Train equipment is adopted and train speeds are arranged without much consideration of the character of the track construction, the cost of maintenance-of-way or the factor of safety involved. If heavier locomotives and heavier, faster and more numerous trains become necessary to handle the business of an existing road, little consideration is given to the ability of the track to carry the increased loads and traffic with safety and economy. Many engineers and roadmasters have experienced the increasing difficulty in maintaining track which has not been improved or strengthened to correspond with the increased service of recent years.

As concerns improvements in specific detail we must first of all hope for rails of better quality and of such weight and section as are adapted to the loads and stresses imposed upon them. Other details may be noted as follows: (1) Rail joints that more fully meet the requirements as to strength and continuity; (2) screw spikes or other fastenings superior to the common driven spike; (3) deeper and stiffer ties of such size or number as to give an adequate bearing area for the distribution of the loads; (4) ties of steel, concrete and treated wood; (5) better quality and ample quantity of ballast; (6) a better consolidation of the roadbed; (7) the employment of a higher quality of labor for the work of maintenance-of-way. In view of the severe stresses imposed upon the track at curves by fast and heavy trains, attention may be called also to the desirability of strengthening the track at such places. This may be effected by the use of tie-bars or tie-rods to connect the rails, or by the use of special rail-supporting chairs which will enable the rail to resist the lateral pressures and will also distribute these pressures over ample fastenings to the ties.

Improvements in these details, guided by proper study of railway track as a unit structure, are capable of bringing track of the present standard type to a condition far ahead of anything yet attained. Increased safety of traffic and a reduction in maintenance expenses may be obtained by improvements in this type of track, without waiting for the problematical development of some new type of track construction, however beneficial the latter might prove when in actual use. Improved or special construction at large first cost may, however, prove economical for busy sections of lines having very heavy traffic, and on which the difficulties and cost of track maintenance are extreme.

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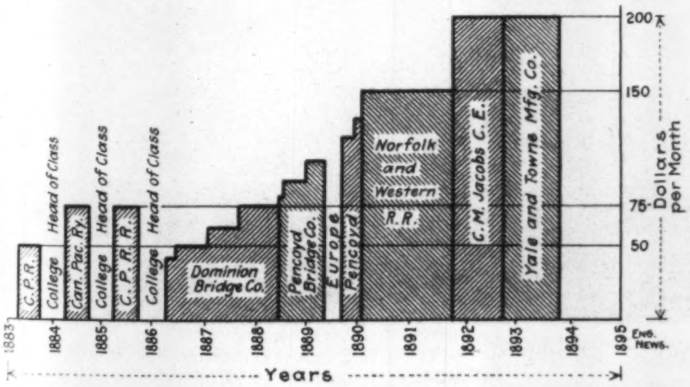
LETTERS TO THE EDITOR.

The Salary of Young Engineering Graduates: A Personal Experience.

Sir: In Engineering News of Aug. 6, "$1,400" takes rather a gloomy view of engineering remuneration. An engineer or any other man receives only what he is willing to work for and no more.

When I graduated from college, Prof. John Galbraith, now President of the Canadian Society of Civil Engineers, and who was one of the Royal Canadian Commissioners to investigate the Quebec Bridge disaster, gave me some very good advice, which I followed. He recommended getting as wide and varied an experience as possible during the first ten years—before settling down to any specialty. And I found that by getting my salary raised as I went along, the best kind of work was assured, for an employer does not like to see his higher-priced men doing work that the cheaper man can do well enough.



SALARY RECORD OF AN ENGINEER FOR TEN YEARS DURING AND AFTER COLLEGE.

I enclose a graphical record of my first ten years, which may or may not interest your readers.

Very truly yours,
T. Kennard Thomson.
50 Church St., New York, Aug. 6, 1908.

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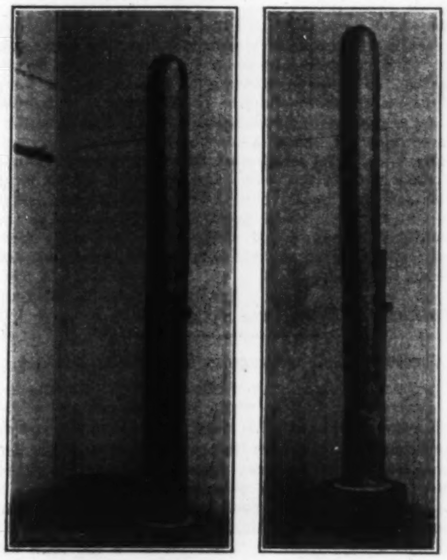
A New Protection Against Corrosion of Anchor Bolts.

Sir: Enclosed find two photographs of vitrified protectors for anchor bolts such as are used in column foundations, bridge anchors and various purposes where the bolts are set in concrete foundations, the use of such vitrified protectors are for the purpose of preventing the destruction of enclosed bolts by electrolysis and also to prevent the escape of electricity through columns to bolt and then to metallic substances as water mains, etc., where this corrosion may cause leaks and necessitate the renewal of pipes.



Vitrified Protector for Anchor Bolts.

They can also be used to advantage in steel structures set on concrete grillage foundations to insulate foundation bolts thus preventing the escape of electricity through bolts to the reinforcing in the grillage.

Being a reader of your magazine I thought it would be interesting to note this new idea.

Yours respectfully, R. T. Kanski.
607 Union Ave., Bronx, N. Y. City, July 6, 1908.

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The Effect of Moisture on the Bulk of Dry Sand.

Sir: The following notes on the effect of moisture in increasing the bulk of dry sand, I trust may be of interest.

On p. 176 of Taylor & Thompson's "Treatise on Concrete" there is a paragraph headed "Effect of Moisture on Sand and Screenings" in which the authors call attention to the fact that dry sand, upon moistening, occupies more space in its moist state than when dry and they give as their explanation, that the effect of the moisture is due to the fact that a film of water coats each grain of sand separating it by a surface tension from grains surrounding it. As an example of this, they refer to a photograph of moist Ottowa sand containing 6% of moisture in which the grains are clearly seen to be further apart than a sample of the same sand dry.

A little farther on they refer to the fact that if the sand is completely saturated with water it will occupy less space than when dry. It seems to the writer that this is a contradiction, as in both cases, the sand grains are covered by a film of water, and were it the film of water around each grain that caused the increase in bulk the results obtained would be the same whether the sand was merely moistened or completely saturated, the tendency, if any, being toward a greater bulk upon complete saturation, than when only partially moistened, as, with complete saturation there would be absolute certainty of each grain being covered with a film of water, which would not be the case in sand but partially moistened.

The explanation the writer has to offer for the increased bulk in dry sand upon moistening is as follows: When dry sand has only sufficient moisture added to it to make it of what might be termed a "sticky consistency" and is then disturbed so as to permit the re-arrangement of the grains, the innumerable number of fine particles which previously rested in the voids of the coarser particles adhere or "stick" to the larger particles, and in this manner prevent the sand from packing as closely as when dry, it being clear that when perfectly dry the sand is what might be termed "slippery" there being no tendency for the finer particles to coat the larger, thus permitting the large particles to pack closely together and the fine ones to occupy the voids between. This seems to be proved by the fact that upon addition of sufficient water to produce saturation, the sand again returns to the same or less bulk than when dry, the water in this case acting as a lubricant and permitting the same close packing as when perfectly dry.

Very truly yours,
Harold D. Elfreth.
1700 North 12th St., Philadelphia, Pa., Aug. 8, 1908.

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Silting Up of Reservoirs.

Sir: In your issue of July 30, 1908, Mr. R. H. Bolster, of the U. S. Geological Survey, has given several references regarding "Silting Up of Reservoirs" in reply to the question of C. H. M. It may be of interest to add another item to the list given by Mr. Bolster.

At the preliminary hearing on the proposed Appalachian and White Mountain forest reserves before the Committee on Agriculture, House of Representatives, on Jan. 30, 1908, Mr. Chas. E. Waddell, of Asheville, N. C., cited an instance of silting up in a reservoir at the mouth of Beaver Dam Creek. By actually cross-sectioning the delta at the mouth of this creek, he found that in one year 12,000 cu. yds. of sediment had been brought down by the creek from a drainage area, bare of forest, 14 sq. mi. in extent.

This statement may be found in the report of the above preliminary hearing, and is again quoted in the report of the hearing on "House Resolution No. 208," before the Committee on Judiciary, House of Representatives, Feb. 27, 1908.

Very truly yours,
F. W. Scheidenhelm,
Structural Engineer, West Penn Rys. Co.
Connellsville, Pa., Aug. 7, 1908.

Sir: In reference to C. H. M.'s query as to the silting of old reservoirs, which you mention in your issue of July 23, the writer would say that the best record of reservoir silting in this country, known to him, is given in Prof. Taylor's paper on the Austin Dam (Water Supply and Irrigation Papers, U. S. Geological Survey, No. 40, pp. 36-41). The facts recorded therein are as follows: The Austin dam, on the Colorado River, was about 60 ft. high and had no sluices in the body of the dam; the bottom of the penstocks supplying the power plant were about 12 ft. below the crest of the dam; the Colorado River is issuing from a long range of mountains and is a heavy silt bearer. From 1893 to 1897 the reservoir silted up 38% of its original capacity; in February, 1900, a few weeks before the destruction of the dam, the reservoir had silted up 48%. On page 41 of Prof. Taylor's monograph is shown a curve and also a table illustrating the probable silting of the reservoir (also called Lake McDonald). According to this diagram if the dam had remained intact the silt would have reached, in 1900, a depth of about 48 ft., or to the level of bottom of penstocks. After that time it is believed that the progress of the silting would have been very small; reasons for this belief are given below.

In India there are many hundreds of "tanks" or reservoirs built by the Hindoos at different times for irrigation purposes. They were generally formed by building an earth or masonry dam across streams. Some of these structures are 1,100 years old and over. Many of these tanks are still in use, and it is probable that, generally, they have silted up to the level of the intake and the dams act now more as diversion than storage dams. Col. Mullin's "Irrigation Manual" and W. L. Strang's "Indian Storage Reservoirs" (both E. & I. N. Spron) give statistics and particulars about the tanks. Prof. Alfred Chatterton, of the College of Engineers, Madras, may be able to give information as to the silting of old Indian reservoirs.

In 1905 the writer examined some 43 masonry irrigation dams in the Province of Cavite, P. I. These structures vary from 10 to 80 ft. in height. Several of these dams were built about 1880, some before. All but a few have no undersluices in the body of the dam. The bottom of the intake canal or tunnel is generally placed at from 3 to 6 ft. below the crest of the dam; the intake is placed as high as possible in order to reach more land and deliver the water to lands as near the dam as practicable. The following facts were noticed. In dams having no undersluices the silting, in most all cases, had reached the level of the bottom of the intake. In one case a deposit of some 12 ins. of fine gravel was found in the intake tunnel. In one case the tunnel was blocked, probably by the fall of the roof or by the caving in of one of the shafts, and subsequently the reservoir silted up to the level of the crest of the dam. In two cases there was a shoal formed in the middle of the stream in front of the intake. The top of this shoal was slightly above the crest of the dam and was covered with vegetation and drift; in both cases, however, there was a well defined channel leading to the intake. Both these dams were built before 1880.

Two dams had a small undersluice in the body of the structure near the bottom; in each case the undersluice had an area not exceeding 3 ft. It was remarked that the reservoirs behind these two dams, although much larger in area than the majority of the ones mentioned above, had a good depth of water below the bottom of their intake. This shows the powerful effect of undersluices in preventing reservoir silting.

A remarkable instance of the usefulness of undersluices is given by Buckley (Irrigation Works of India, 2d Ed., p. 81, Spron & Chamberlain, N. Y.). The writer quotes from the above:

> The Bhatgarh reservoir, or Lake Whiting, in the Bombay Presidency, India, impounds a gross volume of 5,313,000,000 cu. ft., of which 3,953,000,000 are available for irrigation. The Yelivandi River, which supplies the reservoir, issues from the Western Ghants and carries in flood as much as 1 in 100 of silt. The dam has fifteen 8 x 4-ft. undersluices, 91 ft. below the crest. The maximum height of the dam is 127 ft. A depth of 15 ft. on the undersluices passes the maximum floods. The maximum volume of such floods in the reservoir is only 3% of its contents when full, and consequently silt cannot be deposited only in this 3% of the total volume. The sluices have now (1904) been in operation for about 12 years, and the lake shows no sign of silting as yet, except for a few hundred yards up-stream of the sluices, which is a matter of no importance. In 1901 the quantity deposited above the sill of the undersluices was only 2,900,000,000 cu. ft.; in 1902 it was 5.9 millions; in 1903, 3.77 millions, or less than 0.1% in 12 years. The decrease in 1903 was probably due to the sluices being kept open longer than in 1902. It appears probable from experience gained elsewhere that eventually, when the basin has silted up to the sill of the sluices, a new river-bed will be formed, extending possibly for 6 or 7 miles above the dam, and an equilibrium will be established, the silt deposited in one season being brought forward and carried along the new channel till it is passed through the sluices, the result being that silting up will be confined to the area up to the 15-ft. contour, and the main body of the reservoir will always be kept clear.

From the record for this reservoir, it appears that it is not correct to believe, as some text-books assert, that deposited silt in reservoirs cannot be moved by subsequent floods.

As to the rate of silting, it is clear that it is a function of the velocity; it depends also on the amount of silt carried in the river, the shape of the reservoir and the height of the dam. The record of silting at Austin and Prof. Taylor's table quoted above, show that the rate of silting is almost directly in inverse ratio to the contraction of volume of the reservoir and consequently also in inverse ratio to the velocity, for average floods. For instance, in 1900, the reservoir being half silted up, the rate of silting was 50% of the rate obtaining on the first year after the construction of the dam. During the first year, according to Prof. Taylor's surveys, the reservoir silted 9.3%; in the 16th year, the surface of the silt being at the level of the bottom of the penstocks, and the reservoir 80% silted, the rate would have been barely 2% per year. If the reservoir had had no intake below the crest of the dam, in the 40th year the reservoir would have been 98% silted and the rate at that time would have been less than 0.2% per year.

The Cavite reservoirs have silted up at nearly the same rate; the majority of the reservoirs with dams from 20 to 80 ft. high have silted up in less than 25 years. The Bancud reservoir, having a comparatively large drainage area, has received floods of great violence and it is said that the depth of water over its crest has been as much as 30 ft. This reservoir has silted up to a point about 1 ft. above the bottom of its intake in less than 21 years.

Any factor which causes a decrease in the velocity of the impounded water favors silting. The greater the height of the dam or the size of the pond, the greater will be the rate of silting. Conversely, the greater the velocity, the less the silting. Exception is, however, made for cases similar to the Baucud reservoir where the violence of the floods and the great velocity is sufficient to bring gravel to the face of the dam. We have seen above that even a small undersluice is sufficient to retard the silting and if the area of undersluices is so proportioned as to pass the floods at a sufficient velocity little or no silting will occur; this has been exemplified at Lake Whiting and also at Assuan on the Nile.

The only remedy against silting, besides undersluices, is the building of subsidiary dams above the reservoir. The Tres Cruces dam in Cavite, a structure 65 ft. high and 550 ft. long at top, is built below the confluence of two streams on which have been erected two other dams, the three dams belonging to the same system.

The two upper dams have intercepted most of the silt and the Tres Cruces dam, built in 1880, has still a good depth of water below its intake.

The silting of a reservoir may or may not be injurious to the operation of appurtenant works. At Austin it did not matter much whether the reservoir silted or not; as long as the waterway remained clear above the bottom of the penstocks or 12 ft. below the crest. It would not have been practicable to lower the intake in order to draw the pond below 10 ft., as this would have interfered seriously with the operation of the turbines. In Cavite most of the rivers flowing in box canyons from 50 to more than 100 ft. deep, and the slope of the bed being considerable, the storage behind dams was small and had no importance for irrigation; the main point was to utilize the normal flow of the stream and deliver it as high as practicable. Having this in view, the dams were built as high as the ground would permit and the possible storage was ignored; the topography did not admit of any other solution.

In cases, however, where the impounded water is delivered in the bed of the stream to a diverting dam below and when every drop of water stored is required for irrigation, as at Lake Whiting, at Assuan and at some of the reservoirs in this part of the country, it is vital to the works that the impounding capacity should be conserved and that silting should be prevented. It is gratifying to know that satisfactory results have been obtained in India and on the Nile. The operation of the large reservoirs now under construction in our western country will be watched with great interest, inasmuch as the conditions of run-off and sluice area differ much from those obtaining at the above-mentioned structures and are as yet untried.

H. F. Labelle.

Silver City, N. Mex., Aug. 3, 1908.

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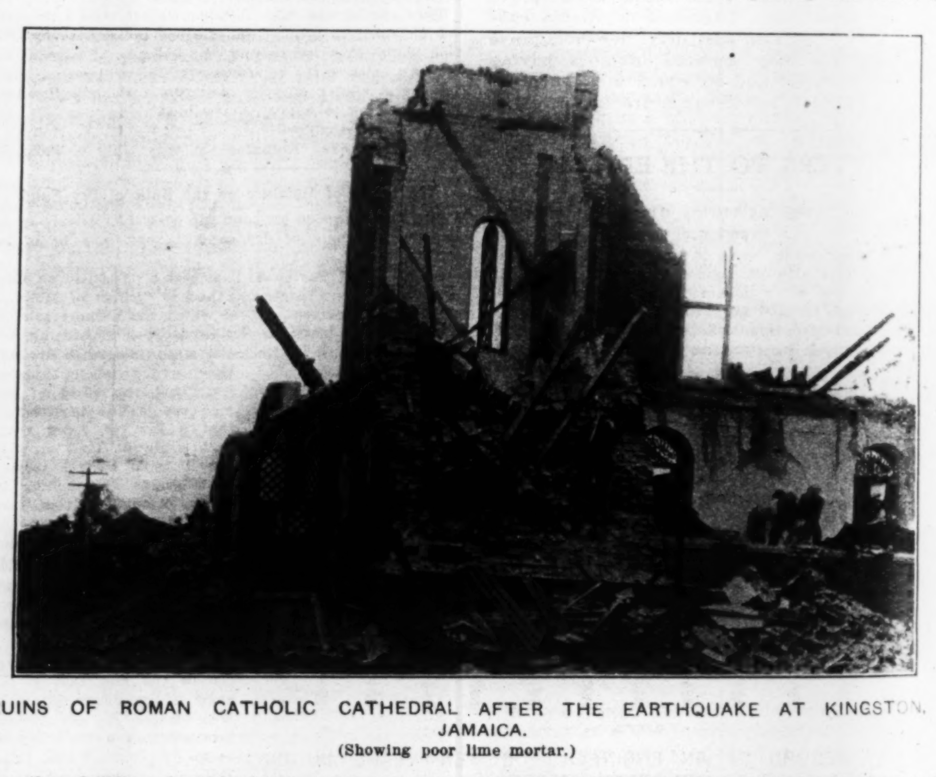
Concrete Block Buildings in Earthquake Countries.

Sir: After reading your publication, "The Manufacture of Concrete Blocks," in which so much excellent advice and suggestion is given I make bold to address you on the subject with the hope that some advice as to the best form for use in Kingston, Jamaica, may be suggested. The book represents the progress of the industry up to the year 1906 and I suppose there is little to add to the excellent specifications for making the block itself, still there is always room for improvement in the form and the adaptation as time goes on; such events as the earthquakes at San Francisco and Kingston surely would have an important influence in these matters. As American material and methods pervade all countries, it is natural that there should be an interest shown by the craft in perfecting systems of construction for Kingston, the rebuilding of which should attract our manufacturers of material and apparatus as well as our building engineers and expert workmen, as is the case in San Francisco. Though Kingston is foreign, in the West Indies English is the language spoken and local labor properly handled is cheap and effectual.



RUINS OF ROMAN CATHOLIC CATHEDRAL AFTER THE EARTHQUAKE AT KINGSTON, JAMAICA.
(Showing poor lime mortar.)

I fail to find any published suggestions of a comprehensive method which would meet conditions of earthquake and hurricane as far as block construction is concerned.

Most of the business portion of Kingston, [illegible] fact all that was destroyed, either business or dwelling houses, was of brick construction, and as the mortar [illegible] was such a poor quality of lime mortar, it is [illegible] considering new construction, to determine how far the shock was responsible and how far the poor material.

It will be seen by the accompanying picture showing the ruin of the Roman Catholic Church (situated outside of the fire line), that the walls actually crumbled; the poor mortar with no holding power separated from the individual brick when the vibrations came and made the great cloud of dust which shut out the sun [illegible] cloud; this was mentioned in the news reports of that issue.

I am convinced, from observation made at the time of the shock and by examinations made later, during the month in which I restored one large dwelling immediately after the catastrophe, that had the material and methods used been of a good average quality there would have been much less destruction. By the building law, which was adopted within a few months following the earthquake, and which is modeled after the English building law (this latter about the same in the main as it was fifty years ago), brick, wood, stone and reinforced-concrete construction are provided for, but concrete blocks are not considered.

Whether this latter form is not dealt with because of lack of experience, information or approval (probably the former) it is not fair to say that it will not be permitted for buildings of a height of 40 ft. and less, especially as there seems to be no inclination to build structures more than two stories high because of the hurricane risks.

Before coming north last June, by request, I drew specifications to provide for the use of concrete block constructions as an amendment to the "Building Law," there being no suggestion of same in the present law, as before noted.

This matter has not as yet been passed upon by the government and criticism upon it and the argument I herein invite. The subject in a general way should be productive of interest for all buildings devoted to manufacturing purposes, wherein there are considerable vibration, as they come more or less in the same class.

Very truly,

H. M. Doubleday.

Sodus Point, N. Y., July 25, 1908.

[That part of the above noted specification which has especial reference to earthquake-resisting construction reads as follows:

The vertical locks between each block, as provided, shall be completely filled by grouting with mortar as heretofore specified, containing three parts of approved broken stone that will pass through a ¾-in. ring, to one part of the mortar mixture. The vertical locks are not to be filled until each horizontal course is leveled up. Horizontal joints between blocks shall be of equal thickness throughout, and not less than ⅜-in.

To insure the integrity of the completed structure against the shock of earthquakes or force of hurricanes, each wall constructed of molded concrete blocks shall be provided with horizontal ties of strap iron, not less than ick and 1¼ inches wide, turned down each ns. and of length to secure all corners and at each fourth horizontal course (or not more ft. in height) bedded in mortar as heretofore

bolts 1 in. outside diameter, with threads and ach end are to be built in the wall, secured in ns at each corner, angle and sides of all open- ending through the air space of blocks to top plate or to under side of coping of parapet wall, to be provided, top and bottom, with wrought- hor plates not less than 4 × 4 × $^3/_{16}$-in.

bolts can be of solid iron, steel or pipe, and to oughly grouted in as specified for the vertical tween blocks.

general argument in favor of the concrete- construction is as follows:

nderlying principle to be considered where fire, uake and hurricane prevail is to provide structures the greatest strength with the least weight in the p. Steel frames of course, combines in the best these two factors, but brings in a condition of ex- not necessary in the case of buildings of limited and breadth, as is the case in the majority of in Kingston.

next type of construction is the concrete block, following reasons:

In that form the greatest strength for the weight is ured, because it uses the material best suited to the purpose in the amount that can be most conveniently handled in a manner to secure the most homogeneous and even mass.

(2) The labor applied in this way to repeat the operation becomes more efficient and trustworthy.

(3) The materials, formed in a specially constructed machine or mold, receive a treatment and manipulation necessary to the best results, and because of the limit in quantities a uniformity in strength and form that cannot be had in any other way is secured.

(4) Because of the necessity for proper curing before any use is made of a concrete mixture either in the wall or block (wherein the mass is intended to bear weight or strain), the block form appears to be the only form in which this can be properly secured. Either the mass must be more expensive or more weighty for its strength, or have outside material combined with it to give the proper quality, which adds to the complication without securing the greatest strength for the least weight.

The fact that it is necessary to cure concrete by frequent wetting protected from sun and wind for 20 to 30 days, according to conditions, in order to secure proper strength, protect against shrinkage in the wall and so secure true and square walls, clearly emphasizes the above.

(5) Because of the provisions for locking the blocks in vertical and horizontal directions as they are laid in the wall, after becoming permanent in size, shape and quality, it is convenient not only to build a wall as strong as the blocks themselves but to make changes in the design and plan of the building as the work goes on.

(6) The provision for use of holding down bolts, erected at the most convenient time, for the bracing of the structure against the forces of earthquake and hurricane, so using the weight of lower walls and particularly the foundation to save weight at the higher points, where in the case of earthquake harm is likely to be done. The greater the weight, the greater the force of the momentum, and when located at the higher elevations the chance of injury is manifestly greater than if the weight was kept lower down and bracing used to add strength as noted.

(7) The use of tying anchors applied when needed only, thus giving detail bracing when needed.

(8) The use of concrete blocks which can be made in the different finish, color or design, an easy way is provided for the planning of tasty, handsome and suitable appearing structures, a feature so desirable in cases where any considerable amount of building is to be done.

For the benefit of the writer and others we would call attention to the latest specification for concrete blocks, that recently adopted by the National Association of Cement Users and published in its latest annual report. Information regarding this specification may be obtained from Mr. R. L. Humphrey, President, Harrison Bldg., Philadelphia.—Ed.]

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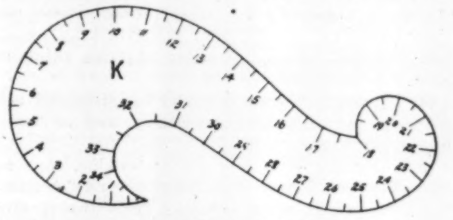
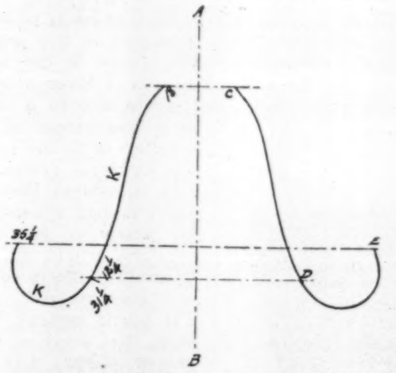
Graduations on the Edges of Curves: A Convenience for Draftsmen.

Sir: It often happens in the design of machinery, etc., that two similar curves, or outlines, must be drawn symmetrically about a given center line. The usual method of accomplishing this is by laying out the curve complete on one side of the center line and then drawing numerous straight lines at right angles to this center line and cutting the given curve. In this way points on the first curve are obtained which may be transferred to the other side of the center line with a pair of dividers. The second curve is then drawn to pass through these points.

A somewhat easier and quicker method in illustrated by the accompanying sketches. The upper sketch represents an ordinary irregular curve, the perimeter of which has been divided on both sides into equal spaces, in this case ⅛-in. spaces. The lower sketch illustrates the method of using a curve so divided. The curve on the left side was drawn first by using portions 18 to 12¼ and 31¼ to 35¼ of the irregular curve. The points C, D and E were then located and the second curve was drawn by using the same portions of this irregular curve in the order named. Thus only three points of the first curve were used for locating the second, and the curves are exact duplicates.



Curve with Graduated Edges.
(Graduations on both sides match.)



Example of Application of Graduated Curve.

In reproducing any curve the only points to be located are at each end of the curve and any intermediate points where different portions of the same curve or various irregular curves are joined. The divisions on the edge of the irregular curves need not be equal, but it is more convenient to have them equal. One of the advantages of a uniform graduation is that the length of any curve can be measured very easily.

It is necessary, of course, that the graduations on the two faces of a single curve should match exactly.

The writer has fitted his entire set of irregular curves with graduations as described. The different irregular curves in the set are lettered A, B, C, etc., the one shown in the sketch being curve K. The curved outline C D E in the lower sketch may then be designated as K 18-12¼, K 31¼-35¼; thus making a complete record of it, and providing for its easy reproduction at any time.

A. L. Campbell.

401 Ferdinand Ave., Detroit, Mich., July 31, 1908.

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FORCED LUBRICATION FOR LOCOMOTIVE JOURNAL BEARINGS.

When run at high speeds and carrying heavy loads, the journals of locomotives often require a large amount of oil for lubrication. Attempts to economize in the oil consumption are rarely successful, as an insufficient supply will result in a hot bearing, with perhaps delay to the train or injury to the bearing. At a recent meeting of the British Institution of Mechanical Engineers at Bristol (England) Mr. T. Hurry Riches, Superintendent of Motive Power of the Taff Vale Ry., described a system of forced lubrication which he and Mr. B. Reynolds had devised for the driving axle of one of the steam motor cars used by the road. The car (Eng. News, July 28, 1904, and Oct. 5, 1905) has a steam truck and a trailing truck, and only one axle of the steam truck is driven by the engine. This truck has 34-in. wheels and a wheelbase of 9½ ft.

The system of forced lubrication was adopted owing to a combination of small journals, heavy loads and high speeds. Its purpose is to effect an economy in oil consumption and to prevent hot bearings. With this in use, the machine has been run 180 miles with two pints of oil, which was a considerable improvement over the consumption when using ordinary lubrication. We quote a part of the paper as follows:

When the car is loaded with its full complement of passengers the weight on the driving axle is 35,056 lbs. The journals are 6 × 9½ ins. The pressure, taking two-thirds of the projected area of the brass as bearing area, is 466 lbs. per sq. in. The journal makes practically 300 r.p.m for a speed of 30 mi. per hr. With this pressure and high rubbing velocity an undue amount of oil was being used with the ordinary method of lubrication, while cases of the bearings running hot were not infrequent.

To a cross-stay in front of the driving axle is fixed a small gun-metal tank of rectangular section. On the side of this tank next to the axle are fitted two small rotary pumps (right and left-handed). One is for forward running, and the other for backward running. These pumps are driven directly from the driving axle by means of a belt passing over a flanged pulley carried midway between the pumps. The pulley contains on each side of it a roller clutch, somewhat similar to a free-wheel arrangement, fixed to the driving spindle of the pumps. By these means the one belt drives either pump forward or backward, the other pump being free.

When the car is in motion, oil is pumped from the tank and forced through a coiled copper pipe to the top of the axle-box. An oil channel 8¼ ins. long, $^9/_{16}$-in. deep, is cut in the crown of the box, leaving a margin of metal at each side of the channel of ⅝-in. flat. When the box is properly bedded to the journal, this is found to be quite sufficient to ensure that it shall be perfectly oil-tight at the pressures attained.

After passing round the journal, the return oil is collected in the well of the axle-box. It is brought back to the tank by means of a flexible pipe, which allows for the rise and fall of the axle-box, care being taken that the reservoir into which the oil is returned is sufficiently below the well to drain it. At each side of the axle-box well a half-ring is fitted with bearing area about ⅝ in. wide. These half-rings are bedded well to the axles. They are supported upon a couple of small coil springs, which hold the rings up to the journal with a fair pressure, and so prevent the escape of oil along the journal on the bottom side.

The supply tank is so arranged that the return oil, after draining from the well, must pass through a filter before being again sent through the pump. The filters in the tank are removable, and are taken out and cleaned at the end of each day's work. The oil is first drawn off through the stop plug, the thicker part of the oil, after straining, being then replaced by a small supply of fresh oil.

The pumps when running fast (at a speed of 30 mi. per hr. they make 440 r.p.m.) deal with a greater quantity of oil than can be accommodated in the circuit at a pressure of 20 lbs. per sq. in., above which it has not been found advisable to work. A relief valve is therefore fitted to each pump, with an adjustable spring which enables the pressure at which each pump shall work to be regulated. The excess oil, when pumping, simply passes through the relief valve and back into the tank. A small pressure gage connected to each pump, and fixed in the cab, shows the pressure of the oil pumped on both forward and backward running. It also acts as an indicator should failure of either pump occur at any time. Should this happen, the ordinary system of lubrication can be applied by means of a lubricating box in the cab. This lubricating box is also necessary to enable oil to be put into the axle boxes after the car has been standing for a day or two, and so avoid starting with dry axle-boxes.

To prevent the oil from the running pump flowing into the other pump and causing it to run backwards, a small ball valve is placed in the three-way piece leading from each pump to the circuit. The movement of the axle-boxes relatively to the tank and pumps was met in the first instance by trying different sorts of flexible piping. Ordinary coiled copper piping was adopted, finally, both on account of its comparative durability and of its accessibility at any time.

The belt drive for the pumps gives a simple method of driving, and allows for a small relative motion of the axle and pulley. It is apt, however, soon to become saturated with oil, and then slipping occurs. An occasional application of one of the various belting mixtures greatly reduces this slipping. When equal relief valve springs were put in, it was noticed that the pressure indicated for forward and backward running varied considerably. This was probably due to the difference in the slip of the belt in each case.

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CLEANING WATER PIPES BY CONTRACT is proposed by the water-works department of the City of Cincinnati, O. Bids for the work will be received until Sept. 1. Mr. J. A. Hiller is Superintendent of Distribution. Pipe cleaning is common enough abroad, but until recently very little has been done in this country. Most or all of the work which has been done of late has been carried out by contract, but so far as we know Cincinnati was the first city to publicly advertise for bids for such work.

PITTING OF THE GATES AND VANES OF HIGH-HEAD WATER TURBINES.

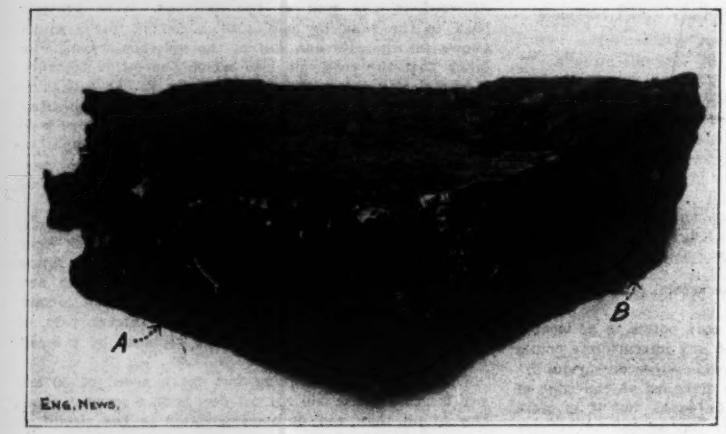
By ROBERT E. HORTON.*

The turbine water wheel under moderate heads and ordinary conditions gives less trouble and requires less repairs than any other form of prime mover. There are many turbines that have been in use 20 years or more with little or no repair, excepting perhaps replacement of the lignum-vitae step bearing. In some of the recent water power developments, where heads of 100 ft. or more are used, certain turbine parts, notably the gates and runner vanes, have lasted from one to five years only.

In cases the writer has observed, the exposed edges were destroyed by pitting, thus giving the metal a honeycomb appearance. Various theories have been advanced to account for this rapid wear, and some engineers are very sure they have found the cause and the remedy for certain plants. As the conditions at different plants are not the same, it appears that the cause of wear may differ in different places.

Without naming the plants, the conditions at three places where such trouble has been experienced are given as follows:

Plant No. 1: Head 265 ft.; outward-discharge or Fourneyron turbines, with outside cylinder gates. The original turbines were of Swiss design with bronze runners and iron gates. The vanes and gates became pitted as shown in the accompanying figure. New bronze gates and runners were put in, but the trouble continued. Careful tests showed no electrolytic action between gates and vanes. Later, new runners of modified design were substituted and no more trouble thus far has been experienced. The stream above the plant is somewhat flashy and flows in a sandy channel. The drainage basin is wooded and swampy. The water is soft, dark colored and carries much humic acid. A sulphite pulp mill a short distance above the power plant discharges waste sulphuric acid into the stream.



A FRAGMENT OF THE OUTSIDE CYLINDER GATE OF A HIGH-HEAD FOURNEYRON TURBINE SHOWING PITTING.

(A) Lower outer edge of cast-iron cylinder. Inner edge shown worn away. (B) Holes eaten through the coating (1 in. thick) about 3 ins. above lower edge.

Plant No. 2: Head 140 ft.; Fourneyron turbines of Swiss design, bronze vanes and iron cylindrical gate rings. The water is drawn from a large lake and is very pure and free from silt. In an adjacent newer plant under similar conditions, but with turbines of a different design, no trouble has been experienced thus far.

Plant No. 3. The turbines were modified American stock patterns, operating under 28 and 44 ft. heads. Some runners were of cast iron and others were of cast steel. The vanes became pitted over an area a few inches in diameter, starting on the convex side of the ladle-shaped outlet, and also near the lower rim band. The water was pure and free from grit. There were sulphite mills farther up stream, but tests showed that the amount of acid in the water was apparently insufficient to cause the trouble. Tests also failed to show any electrolytic action taking place between gates and vanes. No similar trouble is experienced at other mills on the same stream.

Some of the suggested causes of the destruction of the turbine parts in these and other plants where similar trouble has been experienced are as follows:

(1) Attrition by suspended grit in water moving under high pressure, thus forming a sort of "sand blast."

(2) Defective castings having edges or spots full of minute blow holes.

(3) Electrolysis by stray current from electric plants, or especially by "local action" where turbine parts are of different materials as bronze and iron and where the water contains sulphuric acid.

(4) Chemical corrosion aided by dissolved acid and by the increased solvent power of water under pressure.

(5) Chemically active gases (ozone, nascent hydrogen, carbonic or sulphuric acid) released from the water when escaping from the turbine. It is also conceivable that the water particles might be dissociated or broken into their constituents, yielding free oxygen and hydrogen as a result of extreme and sudden changes of pressure.

(6) Defective design, resulting in the production of eddies and violent shock in the water at or near its exit. This would favor attrition if grit was present, and would also be a necessary counterpart of dissociation with the resulting chemical action.

It is evident that the above-named causes, acting singly or jointly as required, would all tend to produce effects similar to those observed.

It seems certain, however, that some of these causes either were not present or else were not sufficient to produce the effects noted. Pitting action has occurred where the castings were unquestionably sound, where there was no external evidence of stray currents or electrolysis, and where the water did not contain appreciable grit, or humic, sulphuric or other acid. Pitting is not altogether confined to high-head turbines, although the great cost and inconvenience of replacing the parts of such wheels makes it of special interest where high pressure turbines of special design are used.

The writer has examined the worn-out runners of very many American stock-pattern turbines and has not run across an example of serious pitting having taken place under a lower head than that noted in case No. 3. Such cases are reported to have occurred, however, and are generally associated with turbines that gave low efficiency from the start, as was also true of some of the wheels previously described.

There is some evidence, therefore, that pitting is in some way associated with eddies and shock near the bucket exits, and is consequently the result of poor design.

THE OPERATION OF THE HYDRAULIC DREDGE, "GENERAL C. B. COMSTOCK;" GALVESTON HARBOR, TEX.

By EMILE LOW,* M. Am. Soc. C. E.

In Engineering News for Aug. 8 and Nov. 7, 1895, were published two articles describing the hydraulic dredge, "Gen. C. B. Comstock," built for the United States Government for use of the Galveston Harbor, Tex. In the annual report of the Chief of Engineers of the U. S. Army for 1907 is published a detailed statement of operations of this dredge, from Sept. 26, 1895, to June 30, 1907, which is of more than ordinary interest to civil engineers engaged in dredging work.

Those interested are referred to the articles in Engineering News mentioned above, but for the benefit of those who have not the time or opportunity for a research there is included here a short description of the dredge.

The dredge was built under a contract with the Bucyrus Steam Shovel & Dredge Co., of South Milwaukee, Wis., dated Oct. 6, 18[illegible]. The vessel was delivered at Galveston, Tex., Aug. 31, 1895. The hull, which is built of wood, coppered below the load line, was built at Perth Amboy, N. J., by Hugh Ramsay. It is 1[illegible]7.0 ft. long over all, 35.5 ft. beam, and 16.0 ft. depth of hold. The main engine is aft, and forward thereof, in order come the boilers, the pumping engines, the after hopper, a compartment containing water tanks, and the forward hopper. The hoppers do not extend to the ship sides, but are contained between longitudinal bulkheads, with a slope favorable to rapid dumping. Twelve valves are located in the bottom of the hoppers. Each valve is hinged on the side next the keel and gives an opening 2 ft. 10 in. × 3 ft. 2 in. These valves are controlled by hand from above deck. The contents of the hoppers is a little over 600 cu. yds. The overflow is about [illegible]3 ins. above the deck, upon which the water falls, to be conducted overboard through the scuppers.

The propelling engine is a fore and aft compound 20-in. and 36-in. diameter by 26-in. stroke. It was built by the Neafit & Levy Ship & Engine Building Co., of Philadelphia, Pa. There are two marine boilers, each 10 ft. in diam. by 11 ft. 6 ins. long. The working pressure is 90 to 100 lbs. The dredging machinery consists of two of the Bucyrus Steam Shovel & Dredge Co.'s improved centrifugal dredging pumps, having 15-in. suctions and discharges. Each pump is driven by a directly connected compound condensing engine, having cylinders 12-in. and 22-in. by 14-in. stroke.

Each of the two suction pipes is 50 ft. long. At the upper end is a cast-steel swivel elbow, connected with the upper stiff joint of the suction pipe by two hinge arms embracing a flexible rubber section. A second rubber section is introduced at a distance of 25 ft. above the drag. Two styles of drag have been used. Those furnished with the boat are similar in design to the drag used on the "Charleston" at Charleston Harbor, S. C., except that on the "Gen. C. B. Comstock" the relief valves are at the top of the drag. Two drags have recently been purchased that are of the style used on the "Gedney" (see Engineering News, April 23, 1908). Only one of the latter has so far been put in use. Thus far the indications are that the Edwards' drag (similar to those on the "Gedney") is superior in sand and the Bucyrus drag in mud and clay. Each suction pipe is raised and lowered by a steam crane, with wire-rope hoisting tackle. Vacuum gages, connected with the suctions, are located conveniently to the winch man, for the purpose of indicating to the latter the state of pressure at the bottom of the drag and in the suction pipes. The contract price for the dredge was $86,000. Under the terms of the contract the dredge was to stand a 10-days' trial before final acceptance by the U. S. Government. This trial was completed Sept. 25, 1895, and the vessel was accepted. Since that time the dredge has been continually employed in dredging when the state of weather would permit, except such time as was required for making repairs.

DREDGING IN GALVESTON HARBOR.

Galveston Harbor embraces an anchorage area of over 1,960 acres. It is land locked by Galveston Island, Pelican Island, the shoals in the bay and Bolivar Peninsula, thereby affording vessels excellent shelter from storms. Waterways connect it with Houston and with Brazos River. The entrance to the harbor, between Galveston Island and Bolivar Peninsula, was originally obstructed by a sand bar on which the depth of water was but 12 ft., a second bar, having a depth on it of 13 ft., existed at the entrance to Galveston Channel, along which the city's water front extends with its systems of wharves.

The project for improving this harbor was adopted in 1874, modified in 1880, and again in the object being to deepen the channel at the entrance so as to permit ocean vessels of the deepest craft to enter the harbor.

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*Hydraulic Engineer, 481 Hudson Ave., Albany, N. Y.

*606 Ashland Ave., Buffalo, N. Y.

The projects of 1874 and 1880 contemplated the construction of two jetties extending into the Gulf of Mexico, so as to concentrate the ebb flow of the tide upon the outer bar and thus gradually wear it away. More or less work was done under these projects.

The project of 1886, also provided for the construction of two jetties extending into the Gulf, one the south jetty, starting from the east end of Galveston Island and following the line of the jetty previously constructed, and the other the north jettty, starting from Bolivar Point. In 1888 it was decided to connect the inner end of the south jetty with a relatively high ground on which the city of Galveston was built by a stone dike, known as the shore branch. The jetties are built of rip-rap covered by granite blocks and are carried to an elevation of 5 ft. above mean low tide, extending to the 30-ft. contour in the Gulf, their sea ends being 7,000 ft. apart.

To remove the shoaling that takes place in the improved channel, the U. S. Government maintains here the "Gen. C. B. Comstock," the dredge which is the subject of this article.

Borings made in Nov., 1895, developed the fact that an irregular layer of clay from 4 to 10 ft. or more thick was partially exposed in 22 to 24 ft. of water between the jetties. In places this clay is largely mixed with sand and shell. When the dredge was first put to work (Sept. 9, 1895,) considerable anxiety was felt as to its ability to dredge the stiff clay that occurred in places. It was found, however, that if given way enough and the pumps worked up to 225 revs. per min. the clay comes up in lumps as large as 6 or 8-in. cubes, that the bins are filled quicker than when sand is dredged, and that there is no trouble whatever in dumping. The makers of the pumps advised a speed of 185 revs. per min. Experience has shown, however, that the "rate per minute" has been increased more than 50% by increasing to 225 revs. per min., and the latter speed is now maintained at all times in sand as well as clay.

The extreme fineness of the Galveston sand and the hard compact surface which it presents to the drag makes it, relatively to the sand at Charleston and Pensacola bars, difficult to raise rapidly and difficult to hold in the bins. Experiment shows that when allowed to fall through a salt water column seven inches in height the average velocity of the Galveston sand particles is 0.67-in. per sec. as compared with 2.26-in. per sec. for sand from Pensacola, and 1.17-in. per sec. for sand from Charleston Bar. Experiment has shown that the ratio of the sand going overboard with the discharge to the sand held in the bins is as 2.8 to 5.

COST DATA.—The following tables show the operations of this dredge from Sept., 1895, to June, 1907:

During most of the time since the work was started the dredge was worked twelve hours each day with a single crew consisting of:

	Per month.		Per month.
1 captain	$125	2 oilers, each	$45
1 mate	90	4 firemen, each	40
1 mate	60	2 winchmen, each	40
1 steersman	75	1 watchman	35
1 carpenter	70	4 seamen, each	35
1 recorder	40	1 cook	50
1 engineer	120	1 cabin boy	20
1 engineer	80	1 cabin boy	15
1 engineer	60	1 laundress	10

Since the dredge was put in commission the sum of $65,037.67 has been spent for ordinary and $104,774.16 for extraordinary repairs. Those charges for the fiscal year 1898, were on account of the dredge becoming unseaworthy, and being put on the marine ways to receive a general overhauling and a renewal of worn out machinery. During the fiscal year 1899 her capacity and efficiency were greatly increased by providing arrangements to use her as a stationary dredge to pump material through a line of pipe and delivering materials on the banks over jetties, breakwaters and bulkheads. This new use is in addition to her former use as a seagoing dredge. During the hurricane of Sept., 1900, the dredge was stranded on Pelican Flats, where she remained until Nov. 2, 1900, when she was floated. The cost of this floating was $21,000 owing to the injuries sustained during the hurricane, the dredge had to be thoroughly overhauled the following year.

During the year 1903 an oil-burning apparatus was installed. The total cost of the change from coal to oil was $2,805, and has resulted in quite a saving, as shown by the following figures:

Cost of 1 ton of steam coal (single crew.)

(1) Average cost per ton	$5.50
(2) Loading coal	.30
(3) Extra stokers	.07
(4) Crew's salary while coaling	1.02
Total	$6.89

Cost of 1 ton of steam coal (double crew.)

(1) Average cost per ton	$5.50
(2) Loading coal	.30
(3) Extra stokers	.03
(4) Crew's salary while coaling	1.57
Total	$7.40

Coal 1 year, December, 1900, to November, 1901.

1,170 tons at $6.89	$8,061.30
Material dredged, cubic yards	526,910
Cost for coal per cu. yd	$0.0153

Oil 1 year, January, 1903, to December, 1903.

7,814 bbls. at $0.881	$6,886.20
Material dredged, cu. yds	592,589
Cost for coal per cu. yd	$0.01162

On June 1, 1904, the dredge was put on a double-crew system, as follows: Crew increased to 40 men, work starting at 4 a. m. and finishing at 8 p. m., the dredge going to anchor every evening in Bolivar Roads, with the exception of Saturday and Sunday nights, when she is berthed at pier to receive supplies.

On July 1, 1906, the dredge was laid up for repairs, but owing to the breakdown of the Galveston Marine Ways, she had to proceed to New Orleans to be dry docked. A thorough overhauling of hull and machinery was entered upon, including the stripping of hull of old copper, calking and resheathing with new copper, new drags and suction pipes, new boiler furnaces, extra oil and water tanks, new tail shaft, and direct-connected generator, etc., at a total cost of $25,983.62. The dredge returned to Galveston and was in commission by the 18th of Oct., 1906.

There follows a detailed statement of operations of the dredge from Sept. 26, 1895, to June 30, 1907.

COST.

Contract price of dredge	$86,000.00	
Fittings, suction pipe, drags, etc.	8,629.84	
Outfit	1,534.55	
Improvement to plant	28,692.29	
Improvement to hull	20,999.51	
Total	$145,856.19	

OPERATION EXPENSE AND REPAIRS.

Ordinary repairs	$65,037.67	
Extraordinary repairs	104,774.16	
Pay-rolls	189,775.30	
Fuel	84,151.06	
Engine-room supplies	13,606.32	
Subsistence	49,850.61	
Miscellaneous	18,231.38	
Total	$525,426.50	
Grand total to June 30, 1907		$671,282.69

TABLE OF MATERIAL DREDGED FOR EACH YEAR AND COST OF DREDGING.

					Per cu. yd.	
Year.	Loads.	Cubic yards.	Operating cost.	Total cost.	Operating cost. cents.	Total cost. cents.
1896	774	419,748	$26,947.82	$31,061.35	6.42	7.40
1897	1,464	806,646	43,218.31	58,143.02	5.35	7.21
1898	1,014	562,976	27,929.33	44,107.51	4.96	7.80
1899	899	500,702	31,129.86	44,712,08	6.22	8.90
1900	301	845,791	29,346.22	33,307.09	4.43	5.03
1901a	807	442,822	33,093.44	60,366.97	7.47	13.65
1902b	336	181,485	14,376.16	44,508.09	7.90	24.50
1903	1,118	613,067	31,367.36	34,522.76	5.10	5.60
1904	1,228	674,497	26,974.65	39,894.67	4.00	5.90
1905	1,999	1,091,640	37,561.25	51,663.76	3.40	4.70
1906	2,394	1,303,865	43,114.36	57,111.61	3.30	4.40
1907c	1,989	1,104,407	47,297.01	77,253.94	4.28	7.00
....	14,323	8,547,646	$392,355.77	$576,652.85	....	....

[a] Includes $21,000 cost of floating dredge which stranded on Pelican Flat during the hurricane of Sept. 8, 1900.

[b] Extraordinary repairs occasioned by severe huricane of Sept. 8, 1900, $27,082 expended.

[c] Extraordinary repairs, occasioned by continual service since 1902.

From 1896 to 1905, inclusive, 10% of cost of dredge was included each year in obtaining the figures of the last column.

No allowance since 1905 for depreciation has been made.

The following is a detailed statement of the operation of the dredge for the fiscal year, ending June 30, 1907.

TABLE SHOWING ITEMIZED UNIT COSTS.

	Money expended.	Cost per cu. yd. cents.
Wages	$19,230.29	1.74
Fuel for boiler (oil)	17,611.57	1.60
Fuel for gallery	250.00	0.02
Water	285.22	0.02
Supplies, subsistence	4,647.39	0.42
Supplies, engine room	1,115.54	0.10
Other supplies	1,962.66	0.18
Ordinary repairs	1,198.27	0.11
Laundry, ice, miscellaneous	734.64	0.07
Tender	262.33	0.02
Extraordinary repairs, alterations and additions to dredge	29,956.03	2,71
Total expended	$77,253.94	6.99

DISTRIBUTION OF EFFECTIVE WORKING TIME.

	Hrs. Min.
Pumping	2,530—08
Dumping	189—47
Going to and from dump	656—44
Going to and from wharf or from anchorage to cut	72—30
Total effective working time	3,449—09

DISTRIBUTION OF TIME LOST WHILE IN COMMISSION.

	Hrs. Min.
Taking fuel and water	71—07
Bad weather	287—10
Washing boilers and ordinary repairs	241—37
Extraordinary repairs	56—30
Sundays and holidays	936—00
Other causes	412—27
Total time lost while in commission	2,004—51

DISTRIBUTION OF TIME LOST WHILE OUT OF COMMISSION.

	Hrs. Min.
Extraordinary repairs	1,332—0
Other causes	498—0
Total time lost while out of commission	1,830—0
Total time accounted for	7,284—0

The above data were obtained from reports of Lieut. (now Major) William V. Judson and Captain John C. Oakes, Corps of Engineers, U. S. Army, and Mr. E. M. Hartrick, Assistant Engineer, and Mr. G. M. Prendergast, Master.

NOTES FROM ENGINEERING SCHOOLS.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—This institution announces that graduate courses in electrical engineering will be given, beginning with the next college year, leading to the degree of Master of Science, Doctor of Philosophy and Doctor of Engineering. The advanced work leading to either doctor's degree, it is announced, will probably follow, as major subjects, the organization and administration of public-utilities companies or advanced alternating currents. The time required for securing the doctor's degree is not definitely announced, but may be inferred from the announcement as two or three years, according to the ability or inclination of the student.

A 1,000-VOLT NARROW-GAGE RAILWAY is projected in Switzerland, to connect the villages of Tamins, Trins, Mulins and Flims with the railway station Reichenau, in the upper Rhine valley, a distance of about eight miles. The difference of elevation between the two termini is nearly 1,500 ft. The maximum gradients as located are 5% and the sharpest curves about 22°; the gage is to be 1 meter. The roadbed and track are estimated to cost about $250,000, the electrical equipment, etc., about $150,000.

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THE NEW CHICAGO TERMINAL STATION of the Chicago & Northwestern Ry. (which was noted in our issue of Aug. 13) will have a trainshed 840 × 320 ft. It will cover 16 tracks, each long enough for a train of 15 cars. The roof of the trainshed will be low, as at the Hoboken terminal of the Delaware, Lackawanna & Western Ry. (Eng. News, Sept. 20, 1906). It will be of reinforced concrete, with steel columns and girders, and will have a longitudinal opening over the middle of each track so as to carry off the smoke and gases from the locomotives. Skylights of wired-glass will be fitted over the platforms. The station will be approached by four main tracks on an elevated structure independent of the line into the present terminal. The general features of the new terminal and its approach were described in our issue of Oct. 18, 1906.

◆

A RECORD COKE PRODUCTION is reported for 1907 in press bulletin No. 345 of the U. S. Geological Survey, as follows:

> The total production of coke in the United States in 1907 amounted to 40,779,564 short tons, valued at $111,539,126, a total that passes all previous records in the history of coke making in this country, being nearly double the output of 1900 and more than three times that of 1897. The increase over the production of 1906 was 4,378,347 short tons, or 12.02%, in quantity, and $19,931,092, or 21.76% in value. The average price per ton at the ovens—$2.74—is greater by 22 cts. than the 1906

average and is the highest reported in the twenty-eight years during which statistics of coke production have been compiled by the United States Geological Survey, exceeding by 11 cts. the former maximum rate (obtained in 1873). The amount of coal consumed in the manufacture of coke in 1907 was 61,946,109 short tons, valued at $72,784,851.

The relative production of bee-hive and retort, or by-product, ovens is given in the following table:

Beehive Ovens:	1907.
Tons production	35,171,665
Per cent. total production	86.25
Tons increase over 1906	3,328,575
Retort Ovens:	
Tons production	5,607,899
Per cent. total production	13.75
Tons increase over 1906	1,049,772

From this it appears that 23.98% of the total increase in 1907 was in the output of by-product ovens.

◆

TO DECREASE RISKS OF COAL MINING is the object of investigations which are being initiated by the Technologic Branch of the U. S. Geological Survey. An explosion experiment station is being equipped at Pittsburg, Pa., under Mr. J. C. Roberts, of the Survey; it will be ready for work by October, but preliminary experiments with explosives in cylinders will be begun in a few weeks. At the same time the methods employed in European mines, both in safeguarding life and in minimizing waste and loss of coal, are to be studied by Mr. G. S. Rice, who has been sent abroad for the purpose.

The direct assistance of European experience has been enlisted by inviting the English, Belgian and German governments to send to this country their experts in mine supervision for the purpose of inspecting our coal mines and advising as to methods of improving their operation. The governments named have courteously acceded to this request. Captain Desborough, inspector of explosives in the British Home Office; Mr. Meissner, of the German Mine Service, and Mr. Watteyne, of the Belgian Administration of Mines, will come here in the course of the present month for the purpose. In company of experts of the Survey they will go on a tour of inspection of coal mines in Pennsylvania, Illinois, Wyoming, Colorado, Alabama, West Virginia and Oklahoma. As the government supervision of mines and investigation of coal mine problems, in the European countries represented by the visiting experts, has resulted in a remarkable reduction of loss of life in the mines, it is reasonable to expect that similar good results will be attained in our mines.

These investigations may be regarded as the direct outcome of the appalling coal mine disasters which occurred during the past year. In the two greatest of these, the Monongah and Darr mine explosions, a total of about 600 lives was lost.

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THE RECOVERY OF GREASE AND FERTILIZER from sewage sludge has been the subject of experiments carried out at the sewage works of Oldham, England, by Dr. J. Grossman, the inventor of the process tried. According to London "Engineering" of recent date:

> The sewage from the main sewer, freed of its coarse suspended matter, passes into settling tanks, where the solids sink to the bottom. After a period of rest the liquid is drawn off and the sediment, containing about 90% of water, is passed through presses by which a large amount of the liquid is squeezed out. The remaining sludge will only contain perhaps 50% of water. Dr. Grossmann takes this portion and, after adding to it certain chemicals, places it in a special retort in which it is subjected to distillation by superheated steam. It is claimed that by this treatment the steam carries off the grease from the sludge, and passing into cooling towers deposits the fatty matter on the water in the form of flakes. In the retort a residuum of fine black dry powder is left, which is odorless and is claimed to be rich in nitrogen.
>
> We understand that the quantity of grease obtainable from the pressed sludge is more than 5%, and the yield of dry residue in the retort amounts to from 7 to 8 cwt. per [long] ton of pressed sludge [800 to 900 lbs. per long ton]. Owing to its being rich in nitrogen the residue will, it is claimed, prove a valuable manure, especially if mixed with phosphates. With regard to the financial side of the process, Dr. Grossmann estimates the value of the grease at between £7 10s. and £10 ($37 to $49) per [long] ton, while the residue is said to be saleable at 6s. 3d. ($1.50) per [long] ton. The cost of the process carried on continuously is said to be about 5s. ($1.20) per [long] ton of pressed sludge, so that on the above figures the treatment shows a considerable margin of profit. The Oldham Health Committee are said to be more than satisfied with the experimental operations so far carried out.

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EXPERIMENTAL DAMS AT GATUN.—A second experimental dam is being constructed at Gatun in the large tank, in which the first dam was made, and on the same scale, 1 to 12. In the first dam the material was pumped in from the downstream toe, the result being that the very fine particles of earthy material, which are most impervious to water, were deposited along the upstream face. A head of water 85 ins. deep in the experimental dam, representing 85 ft. in actual depth, was applied to the upstream face of this dam May 14, and the experiments were continued until a constant rate of seepage had been maintained for a week. All the information needed from the first dam has been procured, and the results are satisfactory beyond expectation.

The material is sandy clay, a deposit of which was found on the Chagres River, in an area distant from the axis of the Gatun dam from three-quarters of a mile to a mile and a half, and in quantity sufficient to construct the Gatun dam. In the construction of the first experimental dam, much of the finer impervious material was lost in the water that drained off, and yet the deposit on the upstream face was very water-tight. The remainder of the material arranged itself in such a way that, although offering great resistance to percolation, any water which penetrated the upstream face drained off readily, and the line of saturation was kept very low. At grade 85, which corresponds to the proposed height of the water in Gatun Lake, the water was held a week. As some question might arise in the lay mind whether the action of the water against a dam one-twelfth of the size of the proposed dam would be the same as in the case of the big dam, the level of the water was dropped to grade 45 and held there for a week. The results of these experiments indicate that the relations between water at grade 85 and grade 45 are very similar.

In the new dam the material will be pumped into the tank from both downstream and upstream faces, in order that more of the fine material may be deposited, as an impervious core, in the center of the dam.

The test pit on Gatun Island, June 11, was 57 ft. deep, and was still in impervious clay. On the same date the test pit in the spillway at Gatun was 56 ft. deep, and the material being encountered was hard, brown conglomerate.—(Canal Record, July 22, 1908.)

◆

BONE COAL IN GAS PRODUCERS.—By permission of the Director of the U. S. Geological Survey, an advance report of results of a test on the behavior of West Virginia bone coal in the gas producer has been made public. This coal was formerly considered of little value as fuel, as it had given poor success under steam boilers.

The coal was delivered on the producer platform in lumps up to 8 or 10 ins. in size. Some of the lumps consisted almost entirely of what appeared to be a high-grade bituminous coal; others seemed to be nothing more or less than heavy, hard rock, and when hit with a hammer gave off sparks. There were many lumps of this rock-like substance to which adhered much good coal. It was necessary to break up the larger lumps in order to fire the coal into the producer and better results might have been attained had a crusher been available. On the fuel bed all the rock-like lumps, when not too large, burned entirely through. There was no tendency to clinker or coke, the bed needing but slight poking. This bone coal contained about 45% ash, which caused the ash bed to increase in thickness very rapidly, and as throughout the test this fact was not properly appreciated, consequently much of the time the ash bed was too high for best results. The large hard lumps, very high in ash, did not burn entirely through, for as soon as the burning was well started a layer of ash formed around the lump, interfering with the combustion of the interior portion. Before the lump had time to burn it passed out unconsumed with the ashes.

Because of the general appearance of the coal, little was expected of it, and the test was started with only partial load. After several hours' run, however, the results warranted full load on the engine. After 39 hours of full load the accumulation of ash in the producer caused a little trouble: the gas went down in heat value, and it was necessary to reduce the load to about 9% of full load. After much grinding down of the ash bed and special care in breaking up the lumpy coal, the gas began to increase in heat value, and at the end of the test the producer was again in shape to maintain full load at the engine. The calculations for the test are based on the 50 hours taken from the time full load was carried by the engine, and for this period the gas averaged 144 B. T. U. per cu. ft., with an average of 97% full load. The following is the result of the test:

Proximate Analysis, West Virginia Bone Coal:	
Moisture	0.47
Volatile Matter	8.83
Fixed Carbon	46.96
Ash	43.74
	100.00
Sulphur	0.27
Composition of Gas by Volume:	
Carbon Dioxide (CO_2)	9.7
Carbon Monoxide (CO)	19.5
Hydrogen (H_2)	16.6
Methane (CH_4)	1.6
Nitrogen (N_2)	52.6
	100.00
Duration of test, hours	50
Coal consumed in producer, as fired; lbs. per hour	378
B. T. U. of coal as fired	8,566
Standard gas per lb. of coal consumed in producer; cu. ft	44.1
Efficiency of conversion and cleaning gas	74.1
B. HP. developed at engine*	228.8
Coal per B. HP.-hr. developed at engine, lbs	1.65

*Based on an assumed efficiency of 85% for generator and belt.

PERSONALS.

Mr. W. N. Haas, Manager of the Haas E[illegible]ering Co., formerly an assistant engineer on the s[illegible] and elevated railway construction of the Philadel[illegible] Rapid Transit Co., has opened a civil and mecha[illegible] engineering office in the Bulletin Building, Philad[illegible], Pa.

Mr. Hugh L. Cooper, M. Am. Soc. C. E., a[illegible] W. V. N. Powelson, Assoc. Am. Inst. E. E., have [illegible] the corporation of Cooper & Powelson, consulting [illegible]aulic and electric engineers, 60 Wall St., New York [illegible] Mr. Powelson will discontinue his connection as [illegible]dent, General Manager and Treasurer of the Union [illegible]ectric Light & Power Co., of St. Louis.

Obituary.

Charles E. Higbee, builder of 49 tunnels, w[illegible] killed Aug. 11 by a broken guy wire at Shoshone, [illegible]., a camp of the Central Colorado Power Co., tw[illegible] miles east of Glenwood Springs.

George W. Harrah, a retired civil engineer, d[illegible] Aug. 13 at Havana, Cuba. He was born in Philadel[illegible] Pa., in 1838, and received his early education in [illegible] city. He completed his education in Switzerland and w[illegible]fterward engaged in engineering work in London [illegible]d in several European countries. He retired from [illegible]ctive business ten years ago because of ill health.

John Scott, prominent in railway affairs, died [illegible]ncer Aug. 11 at the age of 61 years, at his home in [illegible]ompkinsville, Staten Island (New York City). Mr Scott came to this country from England in 1880 a[illegible] from that time until 1886 acted as President of the Al[illegible]ma & Southern R. R. In 1890 he became President of the Colorado Midland Ry. Co., and, returning to N[illegible] York two years later, he acted as a consulting expert in railway matters. As President of the Augusta Cons[illegible]ruction Co. in 1906, he was concerned in the building of 216 miles of road through Georgia and Florida.

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ENGINEERING SOCIETIES.

COMING MEETINGS.

THE TRAVELING ENGINEERS' ASSOCIATION.
Aug. 25. Annual convention at Detroit, Mich. Secy., W. O. Thompson, New York Central Shops, East Buffalo, N. Y.

NEW ENGLAND WATER-WORKS ASSOCIATION.
Sept. 23-25. Annual convention at Atlantic City, N. J. Secy., Willard Kent, 715 Tremont Temple, Boston, Mass.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Sept. 29. Annual meeting at Birmingham, Ala. Secy., R. W. Raymond, 29 West 39th St., New York City.

LEAGUE OF AMERICAN MUNICIPALITIES.
Sept. 30-Oct. 2. Annual convention at Omaha, Neb. Secy., John MacVicar, Des Moines, Iowa.

ILLUMINATING ENGINEERING SOCIETY.
Oct. 6-7. Annual convention at Philadelphia, Pa. Secy., Van Renselaer Lansingh, Engineering Societies' Building, 33 West 39th St., New York City.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.
Oct. 12-16. Annual convention at Atlantic City, N. J. Secy., B. V. Swenson, 29 West 39th St., New York City.

RAILWAY SIGNAL ASSOCIATION.
Oct. 13-15. Annual meeting at Washington, D. C. Secy., C. C. Rosenberg, 12 North Linden St., Bethlehem, Pa.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.
Oct. 20-22. Annual convention at Washington, D. C. Secy., R. H. Reid, Lake Shore & Mich. Southern Ry., Cleveland, Ohio.

AMERICAN ELECTROCHEMICAL SOCIETY.
Oct. 30-31. Fall meeting at New York City. Secy., Dr. J. W. Richards, Bethlehem, Pa.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.—The annual convention will be held Sept. 15-17, at Lenox, Mass.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—The annual meeting will be held Oct. 20-23, at Atlantic City, N. J.

NATIONAL IRRIGATION CONGRESS.—In connection with the sixteenth annual session, which, as previously noted in this column, will be held Sept. 29-Oct. 3, in Albuquerque, N. Mex., there will be an International Industrial Exposition of Irrigated Farm and Forest Products, together with exhibits of other industries and resources of this country.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—The third annual convention will be held Sept. 9, at Toronto, Canada. There will be an exhibition of telephone equipment and supplies. Among the topics for discussion are the following: "Independent Telephones at Railway Stations"; "Organizations of Rural Companies"; "Telephone Rates"; "Exclusive Franchises and Government Regulation."

INTERNATIONAL CONGRESS OF REFRIGERA[illegible]NG INDUSTRIES.—The general committee has annou[illegible]ced that the date of the congress, which is to be hel[illegible] [illegible]his fall in Paris, France, has been postponed and is [illegible]ow definitely fixed at Oct. 5-10. The congress will be [illegible]eld at the Sorbonne. The French committee has expres[illegible] a willingness to set apart a special room for an Ame[illegible]an exhibit of models of refrigerating machinery. Mr J. F. Nickerson, 315 Dearborn St., Chicago, is the secr[illegible]ry of the American committee.

CONSTRUCTION NEWS

Supplement to ENGINEERING NEWS. 220 Broadway, New York, August 20, 1908.

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CONSTRUCTION NEWS.

PLANS AND SPECIFICATIONS ON FILE.

(* denotes that this work is advertised in *Engineering News.*)

The following Plans (P.) and Specifications (S.) are on file and may be seen at the office of The Engineering News Publishing Co., 220 Broadway, New York.

Bids close.	Work. Place.	See issue.
8-20	*Garbage removal, Youngstown, O. (P. & S.)	8- 6
8-20	*Viaduct, Atlanta, Ga. (P. & S.)	8-13
8-21	*Arch bridge, Woonsocket, R. I. (P. & S.)	8-13
8-24	*Cement, Detroit, Mich. (S.)	7-30
8-25	*Paving, Norfolk, Neb. (S.)	8- 6
8-25	*Conduit, Toledo, Ohio (P. & S.)	8-13
8-26	*Riprap seawall, Boston, Mass (P. & S.)	7-30
8-26	*Revetment, etc., Milwaukee, Wis. (S.)	7-30
8-27	Dam, etc., Orland, Cal. (S.)	6-11
8-29	Steel tank, Fort Barrancas, Fla. (P. & S.)	8- 6
9- 4	*Channel, Boston, Mass (P. & S.)	8- 6
9- 5	Elevator, Bremerton Wash. (S.)	8-13
9- 5	Elevators, Norfolk, Va. (S.)	8-20
9- 5	*Prison, Portsmouth, N. H. (S.)	8-13
9- 9	*Water pipe, Springfield, Mass. (S.)	8-13

LIST OF CONTRACTS PENDING.

LIGHT, HEAT AND POWER PLANTS.

8-24	Light plant, New Bremen, Ohio	8- 6
8-25	*Power-house equipment, etc., Port Washington, Wis.	7-30
8-26	*Power-houses, Wheeling, W. Va.	7-30
8-31	Power-house, Wheeling, W. Va.	8- 6
8-31	Wiring, Washington, D. C.	8-20
9- 8	Lighting, Kenosha, Wis	8-13
9-14	Lighting streets, Hartford, Conn.	7-30
9-15	Elec. light plant, Winnipeg, Man.	7-30
9-19	Light plant, Tacoma, Wash	8-13

BRIDGES.

8-20	*Viaduct, Atlanta, Ga	8- 6
8-20	Bridges, Blue, Okla	
8-20	Bridge, Milwaukee, Wis.	8-13
8-20	Iron bridge, Huntingdon, Pa.	8-20
8-21	*Bridge, Woonsocket, R. I.	8- 6
8-22	*Bridge, Rocky River, Ohio	7-23
8-22	Bridges, Spartanburg, S. C.	8-20
8-22	Bridge, Patton, Pa.	8-20
8-24	Bridge, Warren, Ohio	8- 6
8-24	Bridge, Colville, Wash	8- 6
8-24	Bridge work, Oroville, Col.	8-20
8-24	Bridges, Belvidere, Ill.	8-20
8-25	*Bridge, Springfield, Ohio	8-13
8-25	Bridge, Greenville, Ohio	8-20
8-26	Superstructure, Pittsburg, Pa.	8-20
8-26	Bridge, Norristown, Pa.	8- 6
8-27	Bridge, Spokane, Wash	8-20
8-27	Bridge, Waterford, N. Y.	8-20
8-28	Superstructure, Towanda, Pa.	8-20
8-28	Substructure, Irondale, Ohio	8-13
8-28	Bridge work, Columbus, Ohio	8-13
8-29	Culverts, Indianapolis, Ind.	8-13
8-29	Bridges, Lima, Ohio	8-20
8-31	Substructure, etc., St. Clairsville, Ohio	8-13
8-31	*Bridge, Cuba (U. S. Possess.)	7-30
9- 1	*Bridge, Missoula, Mont	8-13
9- 1	Bridge, Two Harbors, Minn.	8-20
9- 1	*Superstructure, Russell, Mass.	8-20
9- 2	*Bridge equip., Chicago, Ill.	7-30
9- 5	Bridge, Cleveland, Ohio	8-20
9- 7	Superstructure, etc., Chillicothe, Ohio	8-20
9- 7	Bridge, Speedwell, Va.	8-20
9- 8	Bridge, Rensselaer, Ind.	8-20
9- 8	Bridge, etc., Salinas City, Cal.	8-20
9- 9	Bridges, Ithaca, N. Y.	8-20
9-14	Bridges, Moscow, Idaho	8-20
9-16	*Bridge, Morenci, Ariz.	8-13

BUILDINGS.

8-20	Hospital, Pittsburg, Pa.	7-23
8-20	Storehouse, New York, N. Y.	8- 6
8-20	Pub. library, New York, N. Y.	8- 6
8-24	Hospital, Chicago, Ill.	8-20
8-21	Post-office, Welland, Ont.	8-20
8-21	*Post-office, Logan, Utah	7-16
8-24	*Buildings, West Point, N. Y.	8-13
8-24	Nurses' home, New York, N. Y.	8-13
8-25	School, Central Falls, R. I.	8-13
8-25	School, Chicago, Ill.	8-13
8-27	Jail, etc., Hillsboro, Ill.	8-13
8-27	*Hospital repairs, Ft. Hancock, N. J.	7-30
8-28	Buildings, Bremerton, Wash.	8-20
8-31	*Heating, Washington, D. C.	8-20
8-31	*Stable, morgue, Washington, D. C.	8-20
9- 1	Hospital, Minneapolis, Minn.	8-20
9- 1	School plans, St. Paul, Minn.	7- 9
9- 1	Post-office, Greenville, Ohio	7-23
9- 1	Laundry, Columbus, Ohio (Mfg. Pl.)	8-13
9- 3	*Buildings, Ft. Monroe, Va.	8-13
9- 5	Elevator, Bremerton, Wash	8-13
9- 5	Prison, Portsmouth, N. H.	8-13
9- 5	Elevators, Norfolk, Va.	8-20
9- 7	Asylum, Rochester, Ind.	8-20
9- 8	*School, Cincinnati, Ohio	8-20
9- 8	*Vacuum system, Wash., D. C.	8-13
9- 9	*Post-office, Sheridan, Wyo.	8-13
9- 9	Court-house, Washington, Ind.	8-20
9-10	Post-office, Kenosha, Wis.	8-13
9-12	Laundry, Ft. Bayard, N. Mex. (Mfg. Pl.)	8-20
9-14	Post-office, St. Louis, Mo.	8- 6
9-15	Factory, Graham, Mo. (Mfg. Pl.)	8-20
9-16	Post-office, Youngstown, Ohio	8-13
9-17	*Vault, Washington, D. C.	8-13
9-17	*Post-office, Escanaba, Mich.	8-13
9-18	Vacuum system, Rochester, N. Y.	8-20
9-21	Post-office, Little Rock, Ark.	8-20
9-22	Post-office, Greenwood, S. C.	8-20
9-22	Laboratory, etc., Ann Arbor, Mich.	7-23
9-23	Court-house, Green Bay, Wis.	6-18
9-28	*Post-office, Dalton, Ga.	8-20
9-29	*Post-office, Bridgeton, N. J.	8-20
9-30	Post-office, Cape Girardeau, Mo.	8- 6
10- 1	*Post-office, Charlottesville, Va.	8-20
10-10	Post-office, Butte, Mont.	8-20

WATER-WORKS.

8-20	Water-works, Hospers, Iowa	8- 6
8-20	Water pipe, Oak Park, Ill.	8-20
8-20	Meters, Cambridge, Mass.	8-20
8-21	Water-mains, Rockport, Ohio	8-20
8-22	Water-works, Keewatin, Minn.	8-20
8-24	Dam, etc., Chambersburg, Pa.	8-20
8-25	Filters, etc., Peekskill, N. Y.	8- 6
8-25	*Conduit, Toledo, Ohio	8- 6
8-25	Water mains, Toronto, Ont.	8-13
8-25	Water-works, Pilger, Neb.	8-20
8-25	Water system, Middlebury, Vt.	8-20
8-26	Water-works, Cottonwood Falls, Kan.	8-20
8-26	Boilers, Owosso, Mich.	8-20
8-26	*Water-works, Rockville, Ind.	8-20
8-26	Cast-iron pipe, New York, N. Y.	8-13
8-27	Dam, Orland, Cal.	6-11
8-29	Water tank, Ft. Barrancas, Fla.	8- 6
8-31	*Canal, Portland, Ore.	8-13
8-31	*Water mains, Wallingford, N. J.	8-13
9- 1	Water-works, Russelville, Ala.	8-13
9- 1	*Concrete conduit, New York, N.Y.	7-30
9- 1	*Filtration plant, Winnetka, Ill.	8- 6
9- 1	Reservoir dam, Marysvale, Utah.	8-20
9- 1	Water supply, etc., North Chicago, Ill.	8-20
9- 1	*Pipe, etc., Livermore Falls, Me.	8-20
9- 1	*C.-I. pipe, Cincinnati, Ohio	8-20
9- 2	*Laying pipe, Boston, Mass.	8-20
9- 2	*Water tower, Platte, S. Dak.	8-13
9- 3	Water system, Fort Sam Houston, Tex.	8-13
9- 4	Wells, Fort McPherson, Ga.	8-20
9- 7	*W.-Works, University, Ala.	8-20
9- 8	Pump, Muskegon, Mich.	8-20
9- 9	*Pipe line, Springfield, Mass	8-13
9-11	Hydrants, Portland, Ore.	8-20
9-13	*Filter cleaning apparatus, Philadelphia, Pa.	8-20
9-16	*Pipe, Morenci, Ariz.	8-13
9-24	*Filtration plant, Evansville, Ind.	8- 6
10- 5	Well, Harrisonburg, Ga.	8-20
10-14	Cast-iron pipe, etc., Vancouver, B. C.	8-13

SEWERS.

8-20	*Sewers, Forest City, Pa.	7-30
8-20	Sewer, Bozeman, Mont.	8-13
8-20	Sewer, Salem, Ohio	8-13
8-21	*Sewer, Louisville, Ky.	7-30
8-21	Sewer, Duluth, Minn.	8-20
8-21	Sewer, Ft. Lee, N. J.	8-20
8-24	Sewer, Fargo, N. Dak.	8-13
8-24	Sewer system, Melette, S. Dak.	8-20
8-24	Sewer, Hartford, Conn.	8-20
8-25	Sewer pipe, etc., Thompsonville, Conn.	8-20
8-25	Sewer system, Limoilou, Que.	8-20
8-25	Sewers, Waseca, Minn.	8-20
8-25	Sewers, Sioux City, Iowa	8-20
8-26	Sewer, Newark, Ohio	8-20
8-27	*Sewer, Paul's Valley, Okla.	8-20
8-27	Sewer, Fort Wayne, Ind.	8-20
8-27	*Septic tank, Seneca Falls, N. Y.	8-13
8-27	Drains, Fort Leavenworth, Kan.	8-13
8-28	Sewers, Durango, Colo.	8-20
8-28	Sewers, Sauk Centre, Minn.	8-20
8-31	Sewer, Frazeyville, Ohio.	8-13
8-31	*Sewer, New Brunswick, N. J.	8-13
9- 1	Sewer, Jackson, Ohio	7-23
9- 2	Sewer, Brooklyn, N. Y.	8-20
8- 3	Sewers, Point Pleasant, N. J.	8-20
9- 4	Sewer, North Braddock, Pa.	8-20
9- 7	*Sewers, Vicksburg, Miss.	7-30
9- 8	Sewer, Hackensack, N. J.	8-20
9-14	*Sewer, Washington, D. C.	8-20
9-14	*Engines, Wash., D. C.	8-13

STREETS AND ROADS.

8-20	Paving, San Antonio, Tex.	8-13
8-20	Macadam, Lebanon, Pa.	8-20
8-20	Paving, Newark, N. J.	8-20
8-21	Pavement, Jamestown, N. Y.	8-20
8-21	Paving, St. Louis, Mo.	8-20
8-21	Grading, Troy, N. Y.	8-20
8-22	*Paving, Washington, D. C.	8-20
8-22	Road, Terre Haute, Ind.	8- 6
8-23	Road, Brookville, Ind.	7-23
8-24	Roads, Fort Barrancas, Fla.	8-13
8-24	*Grading, etc., Freeport, Pa.	8-20
8-24	Roads, Hartford, Conn.	8-20
8-24	Macadam, etc., Lowellville, N. Y.	8-20
8-24	Grading, etc., Braddock, Pa.	8-20
8-24	Asphalt, Glens Falls, N. Y.	8-20
8-24	Curbing, Fulton, N. Y.	8-20
8-25	*Pavement, Norfolk, Neb.	8- 6
8-25	Paving, etc., New York, N. Y.	8-13
8-26	Road impvt, Cleveland, Ohio.	8-13
8-26	*Curbing, etc., Shelby, Ohio	8-20
8-27	Curb, etc., New York, N. Y.	8-20
8-27	*Pavement, Westfield, N. J.	8- 6
8-28	*Macadam, Montvale, N. J.	8-20
8-28	Roadway, Columbus, Ohio	8-20
8-28	Road impvt, Cincinnati, Ohio	8-13
8-29	Road, Williamsport, Ind.	8-13
8-31	Paving, Fort Edward, N. Y.	8-13
8-31	*Street impvt., Mineola, N. Y.	8- 6
8-31	Paving, Appleton, Wis.	8-20
9- 1	*Paving, etc., Caney, Kan.	8-20
9- 1	Paving, Beaumont, Tex.	8-20
9- 1	Paving, Defiance, Ohio	8-20
9- 2	Regulating, etc., Brooklyn, N. Y.	8-20
9- 2	*Sidewalks, Pascagoula, Miss.	8-20
9- 2	*Macadam, Jamesburg, N. J.	8-13
9- 4	Road repair, Cincinnati, Ohio	8-20
9- 5	Roads, etc., Fort Mackenzie, Wyo	8-20
9- 5	Street impvt., Fond du Lac, Wis.	8-20
9- 5	Road, Terre Haute, Ind.	8-13
9- 7	Road, Danville, Ind.	8-13
9- 7	Road, Liberty, Ind.	8-13
9- 7	Road, Mankato, Minn.	8-20
9- 7	Sidewalk, Osceola, Iowa	8-20
9- 8	Road, Vincennes, Ind.	8-13
9- 9	Roads, Muncie, Ind.	8-13
9-10	Road, Lafayette, Ind	8-20
9-14	*Macadam, Decatur, Ala.	8-20

MISCELLANEOUS.

8-20	Levee, New Orleans, La.	8-20
8-20	Tile drain, Eldora, Iowa	8-13
8-20	Trans-Continental Ry., Ottawa, Ont. (Railways)	7-30
8-20	Drainage, Piggot, Ark.	8-20
8-21	Garbage disposal, etc. (Garbage), Vincennes, Ind.	8-13
8-21	Drain, Paris, Ill.	8-13
8-22	*Stone, New York	8- 6
8-22	Railroad, Lake Charles & Northern R. R.	8-20
8-24	*Trav. crane, Dallas, Tex.	8-20
8-24	Cars, gages, cross-ties, Panama	8- 6
8-24	*Cement, Detroit, Mich	7-30
8-24	*Earth excavation, Detroit, Mich.	7-30
8-24	Levee, New Orleans, La.	8-13
8-25	Levee, Alexandria, La.	8-20
8-25	*Crematory, Fort Andrews, Mass.	7-30
8-25	*Seawall, Ft. Mason, Cal.	8- 6
8-25	Engineering supplies, New York.	8-20
8-26	*Metal work, Hawaii	7-30
8-26	*Revetment, etc., Milwaukee, Wis.	7-30
8-26	*Riprap seawall, Boston, Mass.	7-30
8-26	Fire-boat, fire pumps, Boston, Mass	8-13
8-27	Wharf, etc., Port Townsend, Wash	8-13
8-27	Timber, New York, N. Y.	8-20
8-27	Retaining wall, Brooklyn, N. Y.	8-20
8-28	*Cable, Wash., D. C.	8-20
8-28	Garbage removal, Reading, Pa.	8-20
8-29	*Garbage removal, Youngstown, O.	7-30
8-31	*Dredge, Petersburg, Va.	7-30
8-31	*Cable railways, Panama	8- 6
8-31	Trolley material, Boston, Mass.	8-13
8-31	Riprap, Wilmington, N. C.	8-13
8-31	*Canal, Portland, Ore.	8-13
9- 1	Steel rails, Trans-Continental Ry.	8-13
9- 1	Monument designs, Mexico	5-21
9- 4	*Dredging, Plymouth, Mass.	8- 6
9- 5	*Lumber, etc., Charleston, S. C.	8- 6
9- 5	*Dredging, Philadelphia, Pa.	8-13
9- 5	*Drainage, Annawan, Ill.	8-20
9- 7	*Embankment, Greenville, Miss.	8-13
9- 8	*Cement, Vicksburg, Miss.	8-20
9- 9	*Barge canal, Albany, N. Y.	8-20
9- 9	Sale of railway, Atlantic & Lake Superior Ry.	7-23
9- 9	Sale of Ry., Baie des Chaleurs Ry.	8- 6
9-12	Sale of electric railway property, Mt. Vernon, Ohio	8- 6
9-14	*Dredging, New York, N. Y.	8-20
9-16	*Ry. work, Philadelphia, Pa.	8-20
11- 2	Submarines, Wash., D. C.	8-13

FOREIGN.

8-20	Dock construction, Belgium	7-16
8-27	Water-works, Egypt	8- 6
10- 1	Railway material, Siam	7-16
10-14	Dredging, Spain	7-16
10-29	Reservoir, pipe, India	8- 6
11- 2	Electric plant, Chile	7-16
11- 4	Reservoir, India	8- 6
12- 1	*Sewers, paving, Ecuador	8- 6

CIVIL SERVICE.

8-26	Teacher, Philippines	8-20
9- 2	Scientific Asst., Philippines	8-20
9- 2	Eng. Inspector, Wash., D. C.	8-20
9- 3	Examiner Accounts, Wash., D. C.	8-20
9- 5	Rodman, Albany, N. Y.	8-20
9- 5	Asst. in Legislation, Albany, N. Y.	8-20
9- 9	C. E.-Supt. Constn., New London, Conn.	8-20

RAILWAYS.

ATLANTIC & LAKE SUPERIOR.—Bids will be received until noon, Sept. 9, for the purchase of the Atlantic & Lake Superior Railway, from Caplin to a point at or near Pasebiac, in the County of Bonaventure, Que., where it joins the Atlantic, Quebec & Western Railway, being a total length of 20 miles of railway, and all its rolling stock, equipment and other accessories thereof, including all franchises. Bids will be received by L. A. Audette, Registrar of the Exchequer Court of Canada, at his office at Ottawa, Ont. Bids must be made on printed forms, containing the terms and conditions of the sale, which may be procured on application to Casgrain, Mitchell & Surveyer, Canada Life Bldg., Advocates, Montreal, Que., where all information with respect to the railway may be obtained.

BAIE DES CHALEURS RY.—Bids will be received until noon, Sept. 9, by L. A. Audette, Registrar of the Exchequer Court of Canada, Ottawa, Ont., for the purchase of this line, rolling stock, etc. Railway runs from Metapedia to Caplin, Que., a distance of 80 miles, connecting with other lines at each end.

CANADA.—Preliminary steps have been taken, according to the Toronto "Globe," toward construction of the proposed railway to Hudson's Bay. "The survey is to be pushed with all possible speed, and it is expected that Parliament will receive the report of the surveyors early in January next. This will enable legislation to go through at once so that the work of construction may begin next year. The survey party is now all ready to start. John Armstrong, a well-known railway surveyor, who has had a long experience in railway construction work in the west, will be in charge, with Messrs. Murphy and Law, Engineers of the Railway Department at Ottawa, as his assistants. One hundred men will be divided into four parties. They will survey alternate routes via the Churchill and Nelson Rivers. One party will go straight through to Port Churchill and work eastward to the present terminus of the Canadian Northern at the Pas. Another party wil follow the valley of the Nelson River to Port Nelson. The ultimate choice of route will depend upon the character of the reports brought back as to the relative cost of construction, the suitability of the country for settlement purposes, the climate, etc. A careful examination will also be made of the harbor facilities at Fort Churchill and Port Nelson, and the Government will gather as much information as possible with respect to the probable cost of harbor works and aids to navigation in the bay and straits, so as to be in a position to give the fullest information to Parliament before legislation is passed providing for the construction of the road. The total distance from the Pas to Fort Churchill is 498 miles. To defray the cost of the survey a vote of $100,000 was passed last session. It is expected that the survey can be completed in about 80 days from the time the men take the field. The Government's policy with respect to the actual construction of the road will not be determined until the survey is completed, but it is certain that no time will be lost in beginning the work as soon as Parliament ratifies the necessary expenditure." Noted on July 2.

CHICAGO & NORTHWESTERN.—The company's tracks through Oak Park, Ill., will be elevated. E. C. Carter is Ch. Engr., Chicago. C. S. Hall is Engr. Track Elevation, Chicago.

DENVER & RIO GRANDE.—The Denver & Rio Grande Railway Co., the new corporation combining the Denver & Rio Grande, the Rio Grande Western and several subsidiary railway companies which have been operated as one system for several years, recently filed its articles of incorporation at the office of the County Clerk of Salt Lake County with a capital stock of $88,000,000, which is divided into shares of the par value of $100 each. The officers and directors of the new Denver & Rio Grande Co. are: E. T. Jeffery, of New York, Pres.; C. H. Schlaacks, of Denver, First Vice-Pres.; Stephen Little, of New York, Secy.; J. W. Gilluly, of Denver, Treas., and Joseph F. Vails, of Denver, General Counsel. Other directors in the new company are George J. Gould, of Lakewood, N. J.; Winslow S. Pierce, of New York; Amos H. Caleg, of New Jersey; Howard Gould, of New York; Arthur Coppell, of New Jersey, and Edwin Gould, of New York. Noted on Aug. 6.

INTERCOLONIAL.—The Dominion Government has voted $400,000 for the diversion of this line from Georges River to Sydney Mines by way of Little Bras d'Or from Sydney Mines to North Sydney by the existing line and from North Sydney to Leitche's Creek by way of Upper North Sydney.

KENNEWICK NORTHERN.—Articles of incorporation of this company, capital stock of $5,000,000, have been filed in Washington. Among the incorporators are: H. C. Nutt, Gen. Mgr. of the western lines of the Northern Pacific; G. H. Plummer and M. P. Martin. New lines will be built immediately from Kennewick, Wash., to Adrian in Douglas County on the Great Northern.

LAKE CHARLES & NORTHERN.—Bids are asked by E. B. Cushing, Engr. Constr., 205 San Jacinto St., Houston, Tex., until noon, Aug. 22, for the construction of a branch line of railroad from Gallatin to Rusk, Tex., a distance of eight miles.

MARION & RYE VALLEY.—The Marion & Rye Valley Railway and the Virginia Southern Railway have been consolidated under the latter name. An extension of 35 miles will be built to ore deposits in North Carolina, in which the Virginia Coal, Iron & R. R. Co. is interested. Construction contract has not yet been awarded, but bids are being received to begin work by Sept. 1. W. D. Leeper is Engr. at Marion, Va. Noted on July 16.

MEXICO.—We are officially advised that steps have been taken by the American Smelting & Refining Co., 71 Broadway, New York, as follows toward the construction of aerial tramway at Santa Eulalia, Chihuahua, Mexico: Order for cable and equipment has been placed with the TRENTON IRON CO., Trenton, N. J., for a Bleichert tram, and the towers are now being erected preparatory to placing the cable. The line is expected to be completed during the summer. W. J. Mitchell, Supt. American Smelting & Refining Co., Santa Eulalia, Chihuahua, Mexico, is in charge of the work.

MISSOURI, ARKANSAS & SOUTHWESTERN.—This company has filed with the state authorities at Little Rock, Ark., a request for another extension of time in which to complete the 10% of the line as required in their charter, and the request has been granted. The company was granted a charter in 1905 to build a railroad from Batesville, in Independence County, to Black Rock, in Lawrence County. In March, 1907, an extension of time was asked for and granted, but the present request for additional time states that the recent financial depression prevented the promoters from securing the loans necessary for the prosecution of the work, that a large sum of money has been spent in preparations, such as securing right-of-way and that this right-of-way has been secured for almost all the line. The petitioners assert that if the additional time be granted they are sure they can have the required amount of road built during the 18 months' time which they asked for. R. W. Earnheart is Pres., and I. J. Matthews is Secy., both of Batesville.

*PHILADELPHIA & READING.—See under Miscellaneous Contracts.

SONORA RY.—The reconstruction of the entire length of the Sonora Railway between Nogales and Guaymas, Mexico, has been ordered by the management of the Harriman lines and is approved by the Mexican government, according to the Mexico City "Herald." A grant has been allowed for the free importation of all materials required for the construction of heavier track and more substantial bridges. The work will be started as soon as convenient and will be completed within three years. E. A. McFarland is Ch. Engr., Tucson, Ariz. C. E. Weaver is Resident Engr., Guaymas, Sonora, Mex.

TAMPA NORTHERN.—Company plans to extend its line to Thomasville, Ga. This railroad is now operating from Tampa to Brooksville, Fla., 50 miles, but it is proposed to extend immediately from Brooksville to Dunnellon, Fla., approximately 35 miles. Construction from Dunnellon to Thomasville, 150 miles, will be taken up after line is completed to Dunnellon. Total length of line Tampa to Thomasville will be about 235 miles. W. B. Denham is Gen. Mgr., at Tampa, Fla., is in charge of construction. John Pasco is Ch. Engr., Tampa.

VIRGINIA SOUTHERN.—See Marion & Rye Valley Ry.

WINNIPEG, YANKTON & GULF.—H. L. Miller, Pres., Russell, Kan., advises us that construction contracts will be let in the near future. Company will build a railway from Superior, Neb., to Oklahoma City, Okla., and Woodward, Okla., to Des Moines N. Mex., 800 miles. Capital has been obtained and about 300 miles of right-of-way have been secured. Surveys are partly made. Noted on June 18.

WABASH-PITTSBURG TERMINAL.—H. W. Master, Receiver for the Wabash-Pittsburg Terminal Ry. Co., has received an order from Judge Archibald at Scranton, having charge of the Pittsburg United States Circuit Court, permitting the receivers to dispose of $750,211 in bonds. The money is to be used to defray the expense of repairing the tunnels, etc. Noted fully on July 23.

ELECTRIC RAILWAYS.

BELLEVILLE, PA.—The Belleville & Reedsville Ry. Co. has been chartered to build a line ten miles long in Mifflin County. Capital stock, $100,000. Officers: L. M. Yoder, Belleville, Pres.; S. M. Patterson, Avondale, Vice-Pres., and F. W. Warner, Belleville, Treas.

SYRACUSE, N. Y.—The Syracuse & Suburban R. R. Co. is planning with the aid of the Chamber of Commerce of this city to extend its line to Pompey, N. Y. Noted on Aug. 6.

ONEIDA, N. Y.—The Oneida Ry. Co. has completed arrangements to extend its line from Sherrill to Kenwood and has received authority from the Common Council to operate its cars through to Kenwood. It is stated that under the terms of agreement the company will secure the right-of-way and complete the grading by Dec. 1st, 1908, and within one year from that date will complete the equipment of the road and put the line in operation. C. Loomis Allen is Gen. Mgr., Utica, N. Y.

WEST POINT, VA.—Survey is being made for an electric railway to be built from West Point to Urbanna, 25 miles. C. P. E. Burgwyn, 2 North Tenth St., Richmond, Va., is Engr. The railway may build branches in the peninsula between the York and Rappahannock Rivers as far down as New Point Comfort.

EDGEFIELD, S. C.—The Augusta & Edgefield Electric Railroad Co., it is reported will advertise for bids to survey the route from Augusta, Ga., via Edgefield to Greenwood, S. C. W. P. Calhoun is Chn.; W. A. Strom and S. B. Mays have the matter in charge. Company is to be organized soon.

GEORGETOWN, S. C.—H. C. Case, Pres. of the Georgetown Electric Co., and Laurens Mouzon have applied to the City Council for a franchise to build a street railway in Georgetown.

MANCHESTER, KY.—The Manchester Traction Co. will build an electric railway connecting Barboursville, Ky., and Manchester, a distance of about 24 miles. Capital stock, $100,000. Officers: Louis des Cognets, Lexington, Ky., Pres.; Robert Carnahan, Oneida, Ky., Vice-Pres.; Dr. Hugh R. Manning, Manchester, Secy. and Treas. Noted on April 23.

LEXINGTON, KY.—John Blair MacAfee, Vice-Pres. of the Lexington & Interurban Railways Co., Third and Walnut Sts., Philadelphia, states that contracts have not yet been let for the proposed line from Lexington to Nicholasville, Ky., twelve miles. It is reported that the line will cost complete between $275,000 and $300,000. Additional improvements in Lexington and the construction of the Winchester system will cost from $350,000 to $500,000 more. Noted on July 16.

MARION, IND.—The Marion & Logansport Traction Co. has been incorporated in Indiana to build and operate an electric railway through the counties of Grant, Miami and Cass. The cities through which the lines propose to run are Marion, Sweetsers, Mier, Converse, Amboy, McGrawsville, Loree, Bunker Hill, Logansport, Anoka and Onward. Capital stock, $40,000. Headquarters, Marion. Directors: John O. Spurgeon, Mead S. Hays, John C. Wilson, Alva Williamson, Lewis S. Marks, Victor S. Wise and John Minnick.

ABERDEEN, S. DAK.—The Aberdeen St. Ry. Co. has been incorporated with a capital stock of $250,000 to construct a street railway system for Aberdeen and vicinity, 20 miles in length. Incorporators: Charles T. McCoy, Frank H. Haggerty, H. W. Marple, Frank W. Brooks, S. H. Jumper, Lannar G. Johnson and John A. Houlahan, all of Aberdeen.

HURON, S. DAK.—The Huron St. Ry. Co. has been incorporated in South Dakota to construct about ten miles of track in about Huron. Capital stock, $50,000. Incorporators: John W. Smith, Henry M. Stevens, Harry M. Jewett, of Huron, S. Dak.; William K. Coler, Brooklyn, N. Y.; Norton D. Walling, Milwaukee, Wis.

THERMOPOLIS, WYO.—The Thermopolis & Hot Springs St. Ry. Co. will begin the construction of two miles of standard-gage track soon. Material is purchased. The road will connect Thermopolis, Big Horn and Hot Springs. The overhead trolley system will be used, and the company will rent power from the Hot Springs Electric Light & Power Co. Capital stock authorized, $50,000; issued, $10,000. Bonds authorized, $25,000. Officers: S. A. Broadwell, Pres.; C. M. Broadwell, Secy. and Treas.; J. J. Conlon, Gen. Mgr., all of Thermopolis.

PLAINVIEW, TEX.—The City Council has granted a franchise to the City Railway Co. to build an electric street railway in Plainview. C. D. Lovelace is the promoter. The line will first be built to the depot, then to College Heights.

BELLINGHAM, WASH.—The Nooksack Valley Traction Co. has been incorporated in Washington to build an electric railway from Bellingham to Blaine and Sumas. Headquarters: Bellingham. Capital stock, $1,250,000. Incorporators: W. P. Alward, J. S. Wheeler, J. E. Morrison, Edward Brown, W. H. Jarrett and J. William Welch. Surveys are under way.

GRANTS PASS, ORE.—The Rogue River & Oregon Southern Ry Co. proposes to build an electric railway from Grants Pass to Selma, Ore. The surveys are now being made and it is expected that construction work will be started in December. G. A. Collins is Ch. Engr., Grants Pass.

OREGON CITY, ORE.—F. M. Swift, who is backing the project to construct an electric railway from Oregon City into the Beaver Creek, Molalla and Wilholt Springs sections of Clackamas County, has filed notice of the appropriation of water from the main channel of the Molalla River, to be diverted, about three-quarters of a mile below a point, where the north and south forks of the river come together. Mr. Swift proposed to build a canal or ditch 25 ft. wide at the bottom, 33 ft. wide at the water surface to carry an 8-ft. depth of water, with a grade of 2-10ths ft.

VALLEJO, CAL.—Manuel Madrid, proprietor of the Vallejo Sulphur Springs, is reported to have stated that an electric road will be built between this city and the springs next year.

VANCOUVER, B. C.—Contract has been awarded to IRONSIDES, RENNIE & CAMPBELL, of Vancouver, for grading work on the British Columbia Elec. St. R. R. between New Westminster and Chilliwac, at $180,000. Noted on June 11.

LIGHT AND POWER PLANTS.

(* *denotes that this work is advertised in Engineering News.*)

RANGELEY, ME.—The Rangeley Light & Power Co. is considering the question of doubling the output of its plant during 1909. The improvements will require an expenditure of about $50,000. D. D. Elliott is Pres. and Mgr.

ASHLAND, ME.—C. A. Flint, owner of the electric lighting plant in Ashland, contemplates changing from steam to water power and erecting seven transmission lines.

FITCHBURG, MASS.—The Board of Mayor and Aldermen has granted the petition of the Connecticut River Power Co. for permission to erect its high-tension 66,000-volt wires across the highways in Fitchberg, and also to erect transmission lines of 6,600 volts from its transformer station on Beech St. for the distribution of electricity to the different mills which have contracted with the company for electrical energy to operate their plants.

BATH, N. Y.—The Citizens Electric Service Co. will build a brick and stone power-house, 36 × 84 ft., plans for which have been prepared by W. S. Brickell, Arch., 595 Ellicott Sq. Bldg., Buffalo. Bids for the work will be received by E. J. G. Tower, Mgr., care of the King Iron Works, Buffalo, N. Y.

CANTON, N. Y.—The Canton Electric Light & Power Co. will commence the construction of a concrete and steel sub-station at once, north of the corporation line. Upon completion transformers will be installed which will take power from the Northern Power Co.'s wires from Hanawa Falls for lighting the village.

BOONSBORO, MD.—The Antietam Electric Light & Power Co. has engaged Orville Shifler, Arch., of Hagerstown, Md., to prepare plans for its power plant to be located on Antietam Creek. The company was awarded a contract recently to furnish the city with electricity for lamps for a term of ten years. H. L. Moser, of Hagerstown, is Secy. and Treas.

MARYVILLE, MD.—The Rockford Electric Light Co. will begin the construction of a concrete dam at its power plant on Little River at once. It will replace the present wooden structure. James L. Clark is Mgr.

WASHINGTON, D. C.—Bids are asked by Bernard R. Green, Supt. of Construction, until 2 p. m., Aug. 31, for installing complete, the electric wiring required for the south pavilion of the new building for the National Museum, Washington.

BASIC CITY, VA.—It is stated that the City Council will install an electric light and power plant and will develop about 500 HP. W. H. Page is Mayor.

RICHLANDS, VA.—Plans are being considered by the Town Council for construction of an electric light plant, water-works and sewer systems. C. B. Neel is Chn. of Com.

PULASKI, VA.—We are advised by Edgar C. Wiley, Consult. Engr., Lynchburg, Va., that he is preparing plans for the development of water power 15 miles from Pulaski for lighting the town. The present system of lamps will be used. Estimated cost, $40,000. Bids will be received probably about Sept. 1. John T. Loving is Mayor.

EAST DURHAM, N. C.—The Durham Cotton Mfg. Co. is planning to discard its steam power plant and will install electric generators and motors to operate the machinery in its plant. The improvements will cost about $50,000.

CHARLOTTE, N. C.—S. J. Smitherman and J. C. Hurley are planning to build a dam on Little River, five miles from Troy, for an electric plant to develop 1,000 to 2,000 HP. for operating cotton mills, furnishing power to the Smitherman Cotton Mills, S. J. Smitherman, Pres. It is reported that the management proposes to build another mill to cost $250,000.

MACON, GA.—The City Council is contemplating installation of electric lighting and water plants. J. W. Wilcox is City Engr.

RUSSELLVILLE, ALA.—Contracts for the construction of the municipal electric light plant and water-works system will be awarded about Sept. 1. Edgar B. Kay, of Tuscaloosa, Ala., is Engr.-in-Charge.

GADSDEN, ALA.—The Coosa River Electric Power Co., Roswell H. Cobb, Pres., has engineers at work on plans for its proposed water power plant. The company contemplates building a dam at Lock No. 2 to develop 25,000 to 30,000 HP. for transmission by electricity.

HUMBOLDT, TENN.—The Board of Public Works has awarded contracts for equipment for the municipal electric light plant as follows: To the CHUSE ENGINE & MFG. CO., Mattoon, Ill., for one 250-HP. engine; also a 150-KW., 60-cycle, 3-phase, 2,200-volt engine type generator. W. A. Moore is Supt.

LEXINGTON, KY.—The Lexington & Interurban Railways Co., J. Levering Jones, Pres., will expend between $450,000 and $500,000 in construction of an electric power-house. The GENERAL ELECTRIC CO., Schenectady, N. Y., has contract to furnish the machinery. J. B. Crawford is Gen. Mgr.

PIKEVILLE, KY.—The Pike Light & Power Co. is planning to install a 150-HP. boiler, one 75-KW., 220-volt, direct-current generator and an engine of 100 HP. The company also proposes to establish a day circuit with about 70 fans connected. L. L. Stone is owner.

MAYFIELD, KY.—The Mayfield Water & Light Co. will erect a power plant, 88 × 100 ft., reinforced concrete, fireproof, to cost $10,000. The contract for concrete work and house has been awarded to the WEIDENFELLER CONSTRUCTION CO., Chicago, Ill.

SPRINGFIELD, OHIO.—A power plant is to be installed at the city hospital immediately at a cost of about $15,000. It is proposed to erect a separate building which will be used as a heating plant, laundry and quarters for the help. It will be connected with the main building by a tunnel. W. R. Burnett is Mayor; Robert C. Gotwald, Gotwald Bldg., Springfield, is Arch.

CUYAHOGA FALLS, OHIO.—The following contracts have been awarded by the Board of Public Affairs for rebuilding the municipal electric light plant: For the generator, exciter and switchboard to the CROCKER-WHEELER CO., Ampere, N. J., and for the new engine to the SHEPARD ENGINE CO., of Williamsport, Pa.

FORRESTON, ILL.—George M. Crombie, owner of the local electric light plant, has decided to install a new 35-KW., 2,200-volt, 60-cycle generator with transformer to step up the voltage to 6,600 to furnish electricity for lamps and motors in Adeline, Ill., five miles distant.

WATERLOO, ILL.—The City Council has purchased a site on West Third St. on which it will build an electric light and power plant.

KEWAUNEE, WIS.—Bids will be received by W. Wiesner, City Clerk, until Aug. 27, for the construction of an electric light plant, the work to include the construction of a brick building, pole line and wiring; one 50-KW., 2-phase, alternating-current dynamo, arc light equipment, and an 85-HP. high speed compound condensing steam plant. Plans and specifications can be seen at the office of the city clerk at Kewaunee, and at the office of Oscar Claussen, German-American Bank Bldg., St. Paul, Minn., Consult. Engr.

ST. CLOUD, MINN.—The Union Power Co., recently organized, proposes to build an electric light and power plant in this city. Power for operating the plant will be furnished by the St. Cloud Water Power Co. The company is capitalized at $100,000.

NORTH PLATTE, NEB.—Plans are being made by the North Platte Electric Light & Power Co. for improvements to its plant, including the purchase of a 250-HP. boiler, a 225-KW. generator and an engine of 125 HP. It is proposed to change the system to 3-phase, 60 cycles. The company contemplates a day service. Lester W. Walker is Treas. and Mgr.

SEGUIN, TEX.—The Seguin Electric Light & Power Co. is preparing plans for rebuilding its water power plant and expects to reconstruct its transmission within the next six months. L. A. Voig Mgr.

BOULDER, COLO.—The Colorado Eastern Power Co. intends to constr a reservoir four miles northeast of this The new reservoir is the third to be bu y the company and will be known as Twin Lakes reservoir. It will lie in Secti , 4, 9 and 10, Township 1 N. Range 7 and will cover an area 1½ miles long 1¼ miles wide. The reservoir will hav apacity of 578,470,000 cu. ft. of water. reservoir will be formed by building a nearly a mile long and about 55 ft. across two of the small creeks runnin rough the Boulder oil field. Into the ba us formed the water of Left Hand Creek be turned, and a large amount of th ater from Boulder Creek will be taken he reservoir through the Boulder an hite Rock ditches. The plans of the co ny include the enlargement of these dit and digging an outlet ditch from th eservoir to the river. By means of this rvoir and outlet the company will stor e surplus water during the flood seaso nd during the dry weather will turn it k into the creek for the use of ditch co nies lower down. The estimated cost of e work is $200,000 and the construction o e dams is to begin at once. J. W. E. T r is Supt.

Plans of the Ordell Ditch & Power Co. have been filed with the County rk, showing that the company proposes to develop the hydraulic power of Boulder Creek. The company is a subsidiary concern the Colorado Eastern Power Co. Its plant will be situated on the ground belonging to the Colorado & Northwestern in the western part of the city, and it will depend upon the constant flow of water through the spillways of the Colorado Eastern power plant. The pipe line which the company proposes to construct will begin about three miles up Boulder Canyon, where the water will be taken from the river into a pipe 5 ft. in diameter. The pipe line will run along the south side of the canyon, following the mountain side in some places and in others tunneling through the mountains. When the line reaches the west side of Flagstaff Mountain, it will tunnel straight through the mountain, coming out at a point about 475 ft. above the river. This will give the company a fall of 460 ft. to the power-house, which will be built near Boulder Creek and in the western portion of the city. It is estimated that the company can generate 6,000 HP. from this fall. The pipe line will be 9,490 ft. in length and the expense of building it and the power-house is estimated at $250,000. The work necessitates a tunnel on the south side of Boulder Creek 1,400 ft. long.

COLORADO SPRINGS, COLO.—It is stated that the stockholders of the Empire Water & Power Co. have authorized plans outlined for company improvements by the directors. These include the issue of a mortgage for $1,000,000 on property, half of which will be taken up soon. The company intends to establish power plants at Manitou, Cascade and Green Mountain Falls, and to generate power from its water on the north slope of Pikes Peak. G. A. Taff is Pres.

COLBY, WASH.—W. E. Parker has purchased a 500-acre tract of land, situated near Colby, and is making plans for improvements. A creek runs through the property and it is estimated that it will develop about 1,500 HP. This will be harnessed and used for the purpose of developing light and power for the vicinity. A power plant will be built.

SEATTLE, WASH.—The SEATTLE ELECTRIC CO. has been awarded contract for furnishing electric current for lighting and power for the Alaska-Yukon-Pacific Exposition. H. F. Grant is Mgr., Seattle.

HOOD RIVER, ORE.—The Hood River Electric Light, Power & Water Co. contemplates changing the voltage on part of its lines from 2,200 to 6,600 volts and will purchase about 40 small transformers. W. H. Chipping is Supt.

RICHFIELD, UTAH.—The Richfield Electric Light & Power Co. contemplates installing a 120-KW. generator in its steam plant and 2,000-KW. water power plant on the Sever River. Thomas Brown is Mgr.

LEWISTON, IDAHO.—Preliminary plans are being prepared by the Umatilla Mining Co .for the construction of a power plant at the confluence of the Clearwater River and Ten Mile Creek. The property of the company is located near Orogande. Jacob Schlooser, of Chicago, Ill., is Pres.

POCATELLO, IDAHO.—The Idaho Consolidated Power Co. is planning to install a 1,000-KW. unit at its plant in American Falls, and may extend its transmission lines. W. F. Murphy is Mgr.

MACKAY, IDAHO.—The Lost River Light & Power Co. is planning to erect a hydro-electric plant on Cedar Creek near Mackay to furnish electricity for lamps and motors in Mackay and the copper mines in this vicinity. The transmission line will be ten miles long and will have a voltage of 11,500, which will be raised later to 23,000. The equipment of the plant will include two sets of high-speed turbines operating under a head of 245 ft. direct connected to generators. A pipe line 700 ft. in length will be built. R. L. Rockwell, of Ontario, Ore., is Mgr., and has charge of the construction of the plant. W. J. McConnell, of Boise, Idaho, is Pres.

BRIDGES.

(* *denotes that this work is advertised in Engineering News.*)

MEDFORD, MASS.—We are officially advised that bids have been received as follows by the Metropolitan Park Commission for constructing a reinforced-concrete bridge at Brooks Road, Middlesex Falls Reservation, Medford: Powers Bros., Brockton, Mass., $17,284; Fred. T. Ley & Co., Inc., Springfield, Mass., $12,100; David J. Sheehan, Lynn, Mass., $12,025; H. P. Converse & Co., Boston, Mass., $10,006; John E. Palmer, Boston, Mass., $9,950; Falvey & Kelly, Dorchester, Mass., $9,250; Rowe Construction Co., Melrose, Mass., $9,25 Coleman Br[illegible] Boston, $8,750; Armstrong Concrete S[illegible]y Co., Boston, $8,670; W. A. Murtf[illegible] Boston, $8,095; FRANK WILLIAMS [illegible], Boston, $7,250 (awarded contract.)

*RUSSELL, MASS.—Bids are asked by the Bridge Committee, Russell, until 2 p. m., Sept. 1, for furnishing the superstructure of a bridge over the Westfield River. The bridge will have two spans about 122 ft. in the [illegible] roadway, 20 ft.; sidewalk, 5 ft. Plans may be seen after Aug. 24 at the office of [illegible] E. Parks, Engr. Westfield, Mass. [illegible] C. Parsons is Chn. and E. D. Parks Secy. Bridge Com.

BUFFALO, N. Y.—The Buffalo & Lake Erie Traction Co., W. A. Alderman, Ch. Engr., Brisbane Bldg., Buffalo, will build a double-track structural steel viaduct 1,400 ft. in length near Westfield, N. Y., with concrete piers and approaches. The Western New York Construction Co., 535 Brisbane Bldg., Buffalo, is receiving bids for same from plans prepared by Boller & Hodge, Consulting Engrs., 1 Nassau St., New York. Bids were recently received for construction complete of reinforced-concrete but have been rejected, and construction will now be of concrete approaches and piers with structural steel superstructure.

WATERFORD, N. Y.—Bids are asked by F. C. Stevens, Supt. Pub. Wks., Albany, until noon, Aug. 27, for the work of constructing a plate girder bridge with approaches, over the Champlain Canal at Mohawk St., Waterford, Saratoga County. The work must be completed by Jan. 1, 1909. Frederick Skene is State Engr.

ITHACA, N. Y.—Bids, designs and plans are asked by F. C. Stevens, Supt. Pub. Wks., Albany, N. Y., until noon, Sept. 9, for furnishing and erecting three steel highway bridges over the Cayuga Inlet, at State St., Seneca St., and Buffalo St. Noted on Aug. 13.

OWEGO, N. Y.—It is stated that the Lackawanna R. R. Co. will erect a new and heavier railroad bridge of steel over the Susquehanna River, on the Cayuga Division, in Owego, to take the place of the present iron bridge. It is expected the work of building the concrete piers and abutments to replace the present stone piers will be begun this fall.

HUNTINGDON, PA.—Bids are asked until noon, Aug. 20, by the County Commissioners, for constructing an iron bridge in Clay Township.

TOWANDA, PA.—Bids are asked until 2 p. m., Aug. 28, for the construction of the superstructure of a bridge here. David A. Keefe, Athens, Pa., is Engr.

PATTON, PA.—Bids are asked until noon, Aug. 22, by Patton Township for the erection of a bridge over Henderson Hollow. Harrop, Hopkins & Taylor are Engrs.

PITTSBURG, PA.—Bids are asked until noon, Aug. 26, by F. P. Booth, County Controller, for the masonry and superstructure of Bridge No. 1, Allegheny River, near Hillton Station.

*SALISBURY, MD.—We are officially advised that the contract for the construction of a steel plate girder drawbridge over the Wicomico River at the crossing of Main St., was awarded by the County Commissioners on Aug. 18 to the YORK BRIDGE CO., of York, Pa., at $4,800. Other bidders were: Lauer & Harper Co., Baltimore, Md., $5,243; Roanoke Bridge Co., Charlestown, W. Va., $5,380. H. M. Clark is Roads Engr.

WASHINGTON, D. C.—See under Streets and Roads.

SPEEDWELL, VA.—Bids are received until Sept. 7 for the construction of an iron bridge and abutments. A. L. Porter, Rural Retreat, Va., may be addressed.

SPARTANBURG, S. C.—Bids are asked by Spartanburg County until Aug. 22, for constructing three steel bridges. W. Frank West is Superv.

BROOKHAVEN, MISS.—The Board of Supervisors of Lincoln County have awarded the contract to the OTTUMWA BRIDGE CO., Ottumwa, Iowa, at $4,360 for an additional span to steel bridge across Homochitto River.

CLEVELAND, OHIO.—Bids are asked by the Board of County Commissioners, Wm. F. Black, Clk., until Sept. 5 for constructing a concrete bridge in Middleburg Township, as per Report No. 1996. A. B. Lee is County Surv.

LIMA, OHIO.—Bids are asked until Aug. 29 by the Board County Commissioners, C. W. Johnston, Chn., Lima, for constructing the Baxter steel bridge across Auglaize River, Marion Township; also for a drawbridge across the Miami and Erie Canal, four miles south of Delphos.

CINCINNATI, OHIO.—Bids were opened on July 31 by the Board of Public Service for constructing a bridge over the tracks of the C., H. & D. Ry. at Eighth St. The contract was awarded to the PENN BRIDGE CO., of Beaver Falls, Pa., at $17,443, the itemized bid being as follows: Superstructure work, complete, $16,949; remodeling streets, 350 sq. yds., $1 per sq. yd.; remodeling sidewalks, 1,200 sq. ft., 12 cts. Other bidders were: F. J. P. Brackett, $19,730; King Bridge Co., $22,714; Gramger & Co., $23,400; Mt. Vernon Bridge Co., $23,785; Capitol Construction Co., $23,859; W. H. Potthoff Co., $24,224; Strobel Construction Co., $26,510.

GREENVILLE, OHIO.—Bids are asked until 2 p. m., Aug. 25, by the County Commissioners for designing, furnishing and erecting a steel highway bridge over Shenango Creek here.

CHILLICOTHE, OHIO.—Bids are asked until noon, Sept. 7, by Charles H. Pinto, County Audr., for constructing the superstructures of certain bridges and for two concrete abutments on pile foundation for each of the bridges.

RENSSELAER, IND.—Bids are asked by the Commissioners of Jasper County until Sept. 8, for the construction of a steel bridge across the Kankakee River on the line between Jasper and Porter Counties.

MARION, IND.—The ATTICA BRIDGE CO., of Attica, Ind., has secured the contract for reconstructing the span of the McFeeley Bridge, at $5,984.

MARSHALL, MICH.—The contract for constructing a reinforced-concrete bridge over the Kalamazoo River at South Marshall Ave. has been awarded to O. J. RENIGER, of Marshal, at $6,400.

WOODSTOCK, ILL.—The contract for the construction of a new iron and concrete bridge across Fox River at Rawson's point has been let to the CONTINENTAL BRIDGE CO., Monadnock Bldg., Chicago, Ill., at $6,500, the work to be completed by Nov. 1.

BELVIDERE, ILL.—Bids are asked by the city until 5 p. m., Aug. 24, for the construction of a wooden bridge and also a steel bridge over Kishwaukee River. Joseph W. Fox is Chn. Street and Alley Com.

TWO HARBORS, MINN.—Bids are asked until Sept. 1 by the County Auditor, for constructing an 80-ft. span steel bridge over the Beaver River. Estimated cost, about $4,500.

McALESTER, OKLA.—The Board of County Commissioners on Aug. 5 awarded to the TOLEDO-MASSILON BRIDGE CO., Ohio Bldg., Toledo, Ohio, the contract for constructing five steel bridges in the county at $11,714. The bridges will be located at the following places: One over Gaines Creek at the McNally ferry; one on Rock Creek at Crowder; one on Boggy, near Kiowa; one on Brushy, near Dow; one on Brushy, near Blanco.

TOLEDO, WASH.—The contract for repairing a span of the big Cowlitz River bridge here has been awarded to the NORTHWEST BRIDGE CO. at $3,775.

SPOKANE, WASH.—Bids are asked by J. T. O'Brien, Secy. Bd. Pub. Wks., until Aug. 27, for constructing a reinforced-concrete bridge across the north channel of the Spokane River, on Howard St. Estimated cost, $74,000.

OROVILLE, CAL.—Bids are asked by the Board of Trustees until 8 p. m., Aug. 24, for a rock, gravel and earth fill, etc., for the bridge crossing Feather River from Bridge St. E. J. Mitchell is City Clk.

SALINAS CITY, CAL.—Bids are asked by the County Clerk until 2 p. m., Sept. 8, for the extension of and repairs to the Hilltown bridge jetties on the Salinas River, Monterey County, and for the construction of a concrete bridge across Toro Creek. Lou G. Hare is County Surv.

MOSCOW, IDAHO.—Bids are asked until 2 p. m., Sept. 14, by the Board of County Commissioners for the construction of two bridges. Alex. P. Ramstedt is Clk. Bd.

NIAGARA FALLS, ONT.—The Queen Victoria Park Commissioners have awarded to H. SYMMES the contract for construction in the southern end of Queen Victoria Park, of two stone and concrete bridges, which will be part of the boulevard to be built along the Canadian side of the Niagara River from Niagara Falls to Fort Erie. The contract price for the bridges is $6,000 each.

QUEBEC, QUE.—A board of engineers has been appointed to rebuild the Quebec Bridge. The three members are Henry E. Bautellet, former bridge engineer of the Canadian Pacific Ry.; Maurice Fitzmaurice, Ch. Engr. of the London County Council, and Ralph Modjeska, of Chicago, Ill.

BUILDINGS.

(* *denotes that this work is advertised in Engineering News.*)

AUBURN, ME.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has awarded contract for the construction of a post-office at Auburn, Me., to WOODBERRY & LEIGHTON, 166 Devonshire St., Boston, at $49,937. A complete list of bids was given on July 23.

BOSTON, MASS.—J. W. BISHOP & CO., 107 Foster St., Worcester, Mass., and 683 Atlantic Ave., Boston, have secured contract at about $40,000 for erecting a school building in the Fenway, to be used in connection with the Museum of Fine Arts.

BUFFALO, N. Y.—John W. Gibbs, D. S. Morgan Bldg., Buffalo, will erect a 2-story store and flat building, 120 × 80 ft., at the corner of Elmwood Ave. and Utica St. It will be built of brick and stone, and will cost approximately $40,000. Colson & Hudson, 35 Dun Bldg., are Archs.

The Enos & Sanderson Co., 41 Carroll St., will erect a wholesale hardware and iron warehouse, 107 × 198 ft., of brick, two stories in height, at Swan and Center Sts. Colson & Hudson, Archs., 35 Dun Bldg., have completed plans for same and will call for bids at once.

AUBURN, N. Y.—The Auburn Orphan Asylum will erect an asylum building four stories in height, 112 × 66 ft., with a 4-story wing, 50 × 46 ft., of brick with stone trimmings. Cost, $75,000. Frank H. Armstrong, Seward Block, Auburn, is Arch.

ALDEN, N. Y.—The Alden Hotel & Bath Co. will build a hotel and sanitarium here, of brick with stone trimmings, 120 × 160 ft., three stories in height. W. S. Brickell, 595 Ellicott Sq., Buffalo, is Arch.

ROCHESTER, N. Y.—Bids are asked until 3 p. m., Sept. 18, by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for installing a vacuum system in the U. S. post-office and court-house at Rochester.

ALBANY, N. Y.—The following bids were received by T. E. McGarr, Secy. of the State Commission in Lunacy, on Aug. 12, for furnishing and installing four horizontal tubular boilers at the Hudson River State Hospital, Poughkeepsie: P. Delaney & Co., Newburg, N. Y., $12,380; A. D. Granger & Co., New York, $12,563; E. Rutzler & Co., New York, $11,679; The G. & W. Manufacturing Co., 26 Cortlandt St., New York, $9,243; The R. T. Ford Co., Rochester, N. Y., $9,897; Westinghouse-Church-Kerr Co., 10 Bridge St., New York, $12,350; W. B. Armstrong, Albany, N. Y., $10,585. F. B. Ware is State Arch.

NEW YORK, N. Y.—We are advised by Henry Otis Chapman, Arch., 334 Fifth Ave., New York, that general contract for construcing a 9-story building for Arthur Tooth, at 580 Fifth Ave., has been awarded to FOUNTAIN & CHOATE, 110 East 23d St.

NEW YORK, N. Y.—We are officially advised that J. M. Murphy, Arch., 302 Broadway, New York, has awarded contract for constructing a 6-story brick building for the Mason Stores, Myrtle Ave., and Bridge St., Brooklyn, to W. A. L'HOMMEDIEN & CO., 1 Madison Ave., New York.

Goldwin, Starrett & Van Vleck, Archs., have plans for a 16-story fireproof combined office and loft building to replace the old Everett House on Union Sq., at the northwest corner of 17th St. and Fourth Ave. It is to be erected for the Everett Investing Co., of which William H. Chesebrough is Pres. It will be of brick and granite, with trimmings of limestone and terra cotta, 127.7 × 142 ft., with an extension 57.6 × 69.4 ft. The cost of construction will be $650,000. The plans provide for an enlargement to 20 stories.

Ogden Codman, Arch., 571 Fifth Ave., New York, advises us that he is taking estimates for a 5-story brick and stone dwelling, 30 × 102 ft., to be erected at 18 East 79th St., for J. W. Haven, 100 East 79th St., at a cost of $150,000.

Plans have been filed with the Building Department for a 9-story loft building to be erected for Anna De Jonge at 37 and 39 West Eighth St. It will have a frontage of 46 ft. and a depth of 88 ft. The cost will be $130,000. F. A. Minuth, 425 Fifth Ave., is Arch.

NEW YORK, N. Y.—We are officially advised that the J. E. Olson Construction Co., 39 West 25th St., is taking estimates for a 9-story building to be constructed of steel, brick and stone at 37 East 28th St. The structure will be 41.8 × 98.9 ft. and will cost $185,000. Frederick C. Zobel, 114 East 28th St., is Arch.

Plans have been filed with the Building Superintendent for making over the 4-story and basement dwelling at 618 Fifth Ave. The ground floor is to be used as a branch of the Equitable Trust Co., of 15 Nassau St. The floors above are to be remodeled into bachelor apartments. The cost is estimated at $60,000. Heins & La Farge, 30 East 21st St., and A. C. Jackson, 55 West 33d St., are Archs.

Plans have been filed for three 6-story brick and stone tenements, 42.6 × 86.11 ft., to cost $120,000. The buildings will be built on 135th St., 275 ft. east of Broadway, and will be owned by Harris and Abraham Cohen, 168 Park Row. Charles B. Meyers, 1 Union Sq., is Arch.

HUDSON, N. Y.—We are officially advised that bids were received on Aug. 8 by Charles Strong, Pres. Board of Managers, New York State Training School for Girls, at Hudson, for the construction, heating, and plumbing of Cottages 8 and 9, and for trunk conduit and branches to cottages, road construction and grading. F. B. Ware is State Arch. The general contract has been let to R. RICHARDS & SONS, 42 Elizabeth St., Utica, N. Y.

*BRIDGETON, N. J.—Bids are asked until 3 p. m., Sept. 29, by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction (including, plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. post-office and custom-house at Bridgeton, N. J.

WEEHAWKEN, N. J.—Contracts for the carpenter, mason and plumbing work for the erection of two 10-family apartment houses on Bullsferry Road, near Highwood Terrace, Weehawken, have been awarded to EDWARD J. WESP, 364 West St., West Hoboken, N. J.; JAMES LALA and WILLIAM GILMOUR & CO., 314 Fulton St., Union Hill, N. J., respectively. The houses, which will be built for August Melching, 310 First St., Hoboken, will be of brick construction, five stories in height and will each measure 32 × 65 ft. The fronts of the buildings will be of buff brick and trimmed with terra cotta. Two apartments, each containing five rooms and bath, will be arranged on every floor. The specifications call for tiled vestibule and bathrooms, open plumbing, cabinet mantels, Graff's ranges, dumb waiters and all modern improvements except heat. The estimated cost of construction is $50,000.

JERSEY CITY, N. J.—Among the school improvements contemplated here are: Doubling School No. 29, Claremont Ave.; addition to School No. 15, Dwight St.; addition to School No. 17, Duncan Ave.; new School No. 32, Coles St., between Seventh and Eighth Sts.; new school to replace School No. 3, Bright St. For the above work $900,000 of bonds has been issued.

FORD CITY, PA.—W. G. Eckles, Arch., Lawrence Trust Bldg., New Castle, Pa., advises us that contract for constructing a 2-story brick and stone school building, 184 × 112 ft., has been let to JOHN G. UNKEFER & CO., of Minerva, Ohio. Cost, $85,000.

PITTSBURG, PA.—The Duquesne Warehouse Co., Third and Liberty St., will build a temporary freight depot and warehouse, 80 × 250 ft., in Penn Ave., near the East Liberty station, on the ground of the Pennsylvania R. R. Work will be started at once.

PHILADELPHIA, PA.—Watson, Huckel & Co., Archs., 1211 Walnut St., have won a competition for designing a warehouse to be built at 16th and Callowhill Sts. for the C. C. Knight Co., Incorporated. The structure will cost $150,000. It will be six stories high and will measure 100 × 180 ft. The structural work will be of reinforced concrete and the exterior will be of brick. Estimates will be invited early in the fall.

STACY REEVES & SONS, 1611 Filbert St., have been awarded a contract by Cope & Stewardson, Archs., 320 Walnut St., for two 3-story dormitories, each 50 × 150 ft., for the University of Pennsylvania, at the corner of 36th and Spruce Sts. The cost will be $70,000.

Herman Miller, Arch., 1420 Chestnut St., has been commissioned to prepare plans for the new building to be erected at Kensington Ave. and Huntingdon St. for the Textile National Bank. It will measure 40 × 100 ft. and will cost about $50,000. Alternate estimates will be asked about Sept. 8 for a building of granite and one of terra cotta.

*WASHINGTON, D. C.—Bids are asked until 2 p. m., Aug. 31, by Jesse E. Wilson, Acting Secy., Dept. of the Interior, for installation of an additional heating system for the Freedmen's Hospital and Howard University, and also at 3 p. m. of the same day, for the erection of a stable and morgue at the Freedmen's Hospital.

WASHINGTON, D. C.—Bids were received as follows Aug. 15 by the Commissioners of the District of Columbia for the construction of a workhouse: Thompson-Starrett Co., 49 Wall St., New York, $119,400; Pavarini & Wyne, Munsey Bldg., Washington, $111,000; George A. Fuller Co., Munsey Bldg., Washington, $118,000.

The following bids were received on Aug. 8 by Elliott Woods, Supt. U. S. Capitol Building and Grounds, for bronze elevator enclosures for the Senate office building: Chicago Ornamental Iron Co., 37th St. and Stewart Ave., Chicago, $45,973; Winslow Bros. Co., West Harrison St. and 46th Ave., Chicago, $51,500; Flour City Ornamental Iron Works, 27th Ave. and 27th St., Minneapolis, Minn., $62,535; William H. Jackson Co., 29 East 17th St., New York, $68,677; John Williams, Inc., 556 West 27th St., New York, $70,000; Hecla Iron Works, 118 North Eleventh St., Brooklyn, N. Y., $70,170; Brown-Ketcham Iron Works, Indianapolis, Ind., $72,000; Art Metal Construction Co., 1403 H St., N. W., Washington, D. C., $75,550; L. Schreiber & Sons Co., Cincinnati, Ohio, $76,400; Snead & Co. Iron Works, Jersey City, N. J., $96,112; F. P. Smith Wire & Iron Works, 100 Lake St., Chicago, $99,370.

Following are the bids received for grilles, etc., for Elevators Nos. 1, 2, 3 and 4: Chicago Ornamental Iron Co., $13,617; Winslow Brothers Co., $14,580; Flour City Ornamental Iron Works, $17,550; The Hecla Iron Works (add 15% if let separately), $17,900; The Brown-Ketcham Iron Works, $18,000; William H. Jackson Co., $18,899; Art Metal Construction Co., $18,961; L. Schreiber & Sons Co., $20,543; John Williams, Inc., $22,000; Snead & Co. Iron Works, (work in all floors by Nov. 30, 1908), $23,305; F. P. Smith Wire & Iron Works, $28,570.

Following are the bids received for grilles, etc., for Elevators Nos. 7, 8 and 9: Chicago Ornamental Iron Co., $10,585; Winslow Brothers Co., $11,840; John Williams, Inc., $15,400; Flour City Ornamental Iron Works, $15,660; The Hecla Iron Works (add 15% if let separately), $17,300; William H. Jackson Co., $18,154; The L. Schreiber & Sons Co., $19,139; Brown-Ketcham Iron Works, $19,900; Art Metal Construction Co., $20,228; The Snead & Co. Iron Works (completed by March 30, 1909), $25,278; F. P. Smith Wire & Iron Works, $26,630.

Following are the bids received for grilles, etc., for Elevators Nos. 10 and 11: Chicago Ornamental Iron Co., $7,667; Winslow Brothers Co., $8,970; Art Metal Construction Co., $11,077; William H. Jackson Co., $11,392; Flour City Ornamental Iron Works, $11,425; John Williams, Inc., $12,000; Hecla Iron Works (add 15% if let separately), $12,450; B. Schreiber & Sons Co., $12,898; Brown-Ketcham Iron Works, $14,300; The Snead & Co. Iron Works (work in first, second and third floors by Feb. 28, 1909), $15,551; F. P. Smith Wire & Iron Works, $16,810.

Following are the bids received for grilles, etc., for Elevators Nos. 12 and 13: Chicago Ornamental Iron Co., $12,093; Winslow Brothers Co., $13,975; Flour City Ornamental Iron Works, $14,900; Brown-Ketcham Iron Works, $17,300; William H. Jackson Co., $17,754; Hecla Iron Works, (add 15% if let separately), $18,220; Art Metal Construction Co., $18,537; L. Schreiber & Sons Co., $19,358; John Williams, Inc., $21,000; F. P. Smith Wire & Iron Works, $22,080; Snead & Co. Iron Works (Work in first, second and third floors by Dec. 30, 1908), $27,772.

*CHARLOTTESVILLE, VA.—Bids are asked until 3 p. m., Oct. 1, by James Knox Taylor, Superv. Arch., Treasury Dept., Wash., D. C., for alterations to the U. S. post-office and court-house at Charlottesville.

NORFOLK, VA.—Bids are asked until 11 a. m., Sept. 5, by R. C. Hollyday, Ch. of Bureau of Yards and Docks, Navy Deept., Washington, D. C., for five electric freight elevators at the Navy Yard, Norfolk. Specifications are on file at the office of Engineering News, New York.

GREENWOOD, S. C.—Bids are asked by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., until 3 p. m., Sept. 22, for the construction (including plumbing gas piping, heating apparatus, electric conduits and wiring) of the U. S. post-office at Greenwood.

ANDERSON, S. C.—Bids were received as follows on Aug. 12 by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction of a post-office building at Anderson, S. C.: S. J. Warner, Atlanta, Ga., $44,500; William R. Compton Realty & Building Co., Elmira, N. Y., $45,484; W. M. Mulkey, Anderson, S. C., $43,964; C. M. Guest, Anderson, S. C., $48,409; King Lumber Co., Charlottesville, Va., $37-870; Simons, Mayrant Co., Charleston, S. C., $42,375; Johnson & Matthews, Florence, Ala., $38,254.

DALTON, GA.—Bids are asked by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., until 3 p. m., Sept. 28, for construction complete of the U. S. post-office at Dalton.

NEW ORLEANS, LA.—The city will advertise for bids in September for erecting the Beauregard School building. It will have two stories, 16 rooms, brick, tile roof. Estimated cost, $65,000. Plans and specifications are being prepared by the City Engineer's department. The building will be erected under supervision of Building Inspector. W. J. Hardee is City Engr.

The Whitney Central National Bank,

Charles Godchaux, Pres., will erect a 12-story office structure and a 6-story ornamental tower, costing $1,000,000.

ROCHESTER, IND.—Bids are asked by the Commissioners of Fulton County until 2 p. m., Sept. 7, for the construction of brick poor asylum and a frame barn. G. W. Dubois is County Audr.

INDIANAPOLIS, IND.—The Trustees of Third Christian Church have procured a site at the corner of Broadway and 17th St. and will ask for bids for the construction of a church to be built thereon as soon as plans can be made. Estimated cost, $100,000.

*CINCINNATI, OHIO.—Bids are asked until noon, Sept 8, by the Board of Education for constructing a high school building. Charles W. Handman is Business Mgr., 511 West Court St.

WASHINGTON, IND.—Bids are asked by the Commissioners of Daviess County until Sept. 9, for remodeling the County Courthouse. Thomas Nugent is County Audr.

BEDFORD, IND.—Bids were received as follows Aug. 11 by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction of a post-office building at Bedford, Ind.: F. M. Rood & Co., Tipton, Ind., $57,400; Bedford Stone & Construction Co., Indianapolis, Ind., $45,910; Barnes Bros. Hamilton, Ohio, $46,400; Home Building Co., Louisville, Ky., $53,800; William F. Stillwell, Lafayette, Ind., $46,727; Hanson Bros., Chicago, $50,800; Edward Henry, Tipton, Ind., $63,160.

CHICAGO, ILL.—The plans for a $300,000 improvement on the Cook County Hospital grounds have been approved by William Busse, Pres. of the County Board and the Citizens' Advisory Committee, members of which are William E. Clow, John M. Ewen, E. P. Bicknell and Charles D. Norton. The building, which is to be erected at Lincoln and Polk Sts., is the first of the group to constitute the new infirmary for which a bond issue of $2,000,000 was voted in the last election. The main building will be five stories high, while the three wings will be of four stories. Bids are asked until Aug. 24.

A theater with a seating capacity of 1,800 and to cost $125,000, is to be erected at the corner of Milwaukee and Oakley Aves. for the Monarch Amusement Co. It will be fireproof, three stories high, of reinforced-concrete construction, and will have ground dimensions of 88 × 156 ft. The plans are being prepared by David S. Klafter, Arch., who expects to be ready for bids about Aug. 25.

St. Michael's Roman Catholic Church will build a school at 2054 to 2058 West 48th St., for which plans have been prepared by Rusy & Rezing. It wil front 67 ft. with a depth of 120 ft. and will be of brick and stone. It will cost $75,000.

EVANSTON, ILL.—Bids are to be received at once for the gymnasium given by James A. Patten to Northwestern University. The building will cost $150,000. It will be erected at Sheridan Road and Haven St., Evanston. G. W. Maher, 218 La Salle St., Chicago, is Arch.

PEORIA, ILL.—A 12-story terminal is to be built here at a cost of $450,000 and under the direction of the Jefferson Safe Deposit Co. The general contract has been let to the WESTLAKE CONSTRUCTION CO., 717 Locust St., St. Louis, Mo. The building will have a frontage of 72½ ft. on Jefferson St. and 173 ft. on Fulton St., and will rest upon caisson foundations bearing upon solid bed rock. The height of each story above the first between the floor and ceiling will be 11 ft., making a total height of about 150 ft. Construction will be of a steel skeleton frame with concrete granite, terra cotta and brick, and will be fireproof throughout, the exterior being of polished granite, Bedford stone and ornamental glazed terra cotta, and the interior being finished in tile, marble, mosaic and mahogany. Jenny, Mundie & Jensen, New York Life Bldg., Chicago, are Archs.

SOUTH BEND, ILL.—J. M. Studebaker, Pres. Studebaker Mfg. Co., has ordered plans and will ask for bids soon for the construction of an 8-story building for storerooms, arcade and offices on West Washington St.

MILWAUKEE, WIS.—The erection of a 16-story apartment reinforced-concrete building on Milwaukee St., near Biddle St., is contemplated by the Prinz & Rau Mfg. Co., 659 East Water St. The building is to cost $50,000 and is to be an addition to the Argyle flats. Plans are being prepared by the Ehlert Construction Co.

A 6-story white glazed apartment building is to be erected by Patrick Cudahy at the corner of Mason St. and Juneau Pl. Ferry & Clas, Archs., 419 Broadway, Milwaukee, are completing plans on the new building, which is to cost $100,000. It is to be 234 × 91 ft., and is to have 66 apartments. The interior is to be finished in marble.

MINNEAPOLIS, MINN.—Bids are asked by Thori, Alban & Fisher, Archs., 408 Chamber of Commerce, St. Paul, until Sept. 1 for the superstructure of the Lutheran Deaconess' Hospital to be built at 15th Ave. South and 24th St., Minneapolis, Minn. It will be three stories high, of pressed brick, cut stone and fire proof construction. Cost, $50,000.

MITCHELL, S. DAK.—A commission has been given to Patton & Miller to furnish the plans and specifications for the high school building to be erected here. The building will cost about $80,000 to build. The building will be erected on the block of ground occupied by a ward building and which has been moved to one corner of the block. Work will start within 30 days to excavate for the basement, and it is expected to lay the foundation of the building this year. The basement will be constructed of granite and the walls of pressed brick.

BUTTE, MONT.—Bids are asked by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., until 3 p. m., Oct. 10, for extending, remodeling, etc., the U. S. post-office at Butte.

ST. LOUIS, MO.—Bids are asked until Sept. 3 by the Building Committee of the Board of Education for constructing the proposed Summer High School. It is expected that the contract will be let and work begun early this fall. The building is to be located on Cottage and Pendleton Aves. The lot is 708 × 134 ft. and the structure will have an area of 418 × 104 ft. It will accommodate 500 pupils, and will cost about $350,000. It will have 57 rooms.

LITTLE ROCK, ARK.—The time for opening bids for the construction of the extension (including plumbing, heating apparatus, electric conduits and wiring) of the U. S. post-office and court-house at Little Rock has been extended from Aug. 31 to Sept. 21, at 3 p. m. James Knox Taylor is Superv. Arch., Treasury Dept., Washington, D. C.

JOHN SCHMELZER has been awarded the contract to erect the proposed business block on the east side of Center St., between Sixth and Seventh Sts., to be built by Rev. John B. Morris, Roman Catholic Bishop of Little Rock. The building will cost about $40,000.

SAN ANTONIO, TEX.—Contract for the proposed office building at the corner of Houston St. and Ave. D has been awarded by C. C. Gibbs to BUCHANAN & GILDER, of Fort Worth, Tex., the estimated cost of the building to be $225,000. The contract calls for the completion of the building by Aug. 1, 1909. The Gibbs building will be eight stories and will be one of the most complete office structures in the South.

BOULDER, COLO.—The Guggenheim Law Building for the University of Colorado will be three stories in height, the first story will be two feet below grade, and will be faced with gray stone. The two upper stories will be faced with gray brick and trimmed with Del Norte stone, of which will be built, also, the Ionic columns supporting the pediment over the main entrance. This portico will be reached by a flight of steps 30 ft. wide, with parapet walls on each side. The roof will be of red tile or brick. The size of the main building is 115 × 52.6 ft. outside. The cost of the building will be between $50,000 and $60,000. James Murdoch, Mack Bldg., Denver, Colo., is Arch.

BREMERTON, WASH.—Bids are asked until 11 a. m., Aug. 29, by R. C. Hollyday, Ch. of Bureau of Yards and Docks, Navy Dept., Washington, D. C., for constructing three buildings and their connecting passages for naval hospital at the U. S. Navy Yard, Puget Sound, Washington.

SEATTLE, WASH.—Plans are being prepared by Thompson & Thompson, Archs., Dexter-Horton Block, for a 3-story store and office building at Third St. near Madison for Louis Cohn. Contracts are to be let at once and the cost will be about $50,000.

TACOMA, WASH.—We are officially advised that bids are being received by Darmar & Cutting, Archs., 1111 South C St., Tacoma, for an 8-story building, 150 × 120 ft., for the Continental Storage, Loan & Commission Co. The building will be either of brick, mill construction or reinforced concrete. F. S. Harmon is Pres.

SPOKANE, WASH.—A 5-story addition on the south and one additional story to the present building are to be made by J. G. F. Hieber, Pres. of the Inland Brewing Co., to the 4-story building which he owns at the corner of Second Ave. and Post St. The improvements will cost about $50,000. Preusse & Zittel, Archs., Jamieson Bldg., are drawing plans. The 5-story addition will be 42 × 50 ft. and with the additional story to the present building, will make a structure 100 x 142 ft., five stories high. There will be a full basement under the addition, with two or three storerooms, and the storeroom now facing Second Ave. will be remodeled and divided into two rooms.

SAN DIEGO, CAL.—The F. O. ENGSTRUM CO., Temple and Spring Sts., Los Angeles, has been awarded a contract for construction of the proposed 8-story Timken Block at the corner of Sixth and E Sts.

BERKELEY, CAL.—The Newman Club, State University, Berkeley, will erect a clubhouse here. The site is at the corner of Bonte Ave. and Ridge Road, north of the campus. The plans, which have been prepared by Shea & Shea, Archs., 1425 Post St., San Francisco, call for a building to cost $50,000. The lot is 45 × 135 ft. and the architects have provided for a 2-story and basement building.

SAN FRANCISCO, CAL.—Plans are being prepared by the War Department, Washington, D. C., for the entire rearrangement and reconstruction of the buildings at the Presidio at San Francisco. Plans for barracks and officers' quarters will be ready to submit to contractors soon. These buildings will be constructed of concrete in the modified mission style of architecture. Instead of employing outside architects to design them they are being drawn in the office of the Quartermaster-General, Washington.

The Paulist Fathers have instructed Welsh & Carey, Archs., 40 Haight St., to prepare plans and specifications with estimates of cost of the restoration of old St. Mary's Church at California and Dupont Sts., which was destroyed by fire. The plans are about completed and in a short time they will be ready for the contractors.

OAKLAND, CAL.—The Board of Directors of the German Old People's Home of Oakland have decided to build a 2-story fireproof structure of steel and stone, containing more than 100 rooms and costing over $100,000, to take the place of the Altenheim, which was burned in July. The Board of Directors includes Theodore Gier, 511 14th St.; J. F. W. Sohst, 902 Franklin St.; C. C. Volberg and Mrs. E. Bahls of Oakland.

LEWISTON, IDAHO.—The Northern Pacific Ry. Co., W. L. Darling, Ch. Engr., St. Paul, Minn., has awarded the contract for the general construction of the 2-story pressed brick and cut stone union passenger station here to CHARLES SKOOGLUN, 1105 Jessie, St., St. Paul, Minn. Cost, $50,000.

WELLAND, ONT.—Bids are asked until 4 p. m., Aug. 24, by R. C. Desrochers, Asst. Secy. Dept. of Public Works, Ottawa, Ont., for constructing a post-office at Welland.

TORONTO, ONT.—The Canadian Order of Foresters has purchased a site on College St., Toronto, and will erect a hall at a cost of about $60,000.

VANCOUVER, B. C.—The GENERAL ENGINEERING & CONSTRUCTING CO., Vancouver, has contract to erect an addition to the Glencoe Lodge in this city, at a cost of about $50,000.

McDONALD, NILSON & SNIDER have been awarded the contract for the extension to the General Hospital, Vancouver, at about $95,000.

Contract has been awarded to WILLIAM O'DELL, of Vancouver, for erection of a sanitarium for consumptives at Tranquille, by the Columbia Anti-Tuberculosis Society at $50,000. Complete, with plumbing, heating and furnishings it will cost about $100,000. Work will commence at once.

WATER SUPPLY—IRRIGATION.

(denotes that this work is advertised in Engineering News.)*

*LIVERMORE FALLS, ME.—Bids are asked by Metcalf & Eddy, Consulting Engrs., 14 Beacon St., Boston, Mass., until 10 a. m., Sept. 1, for laying c.-i. pipe and appurtènances, and building a reservoir in Livermore Falls, for the Water District.

MIDDLEBURY, VT.—Bids are asked until 2 p. m., Aug. 25, at the office of the Disbursing Clerk, U. S. Department of Agriculture, Washington, D. C., for installing a pneumatic water supply system at Morgan Horse Farm here. James Wilson is Secy.

*BOSTON, MASS.—Bids are asked until 2.30 p. m., Sept. 2, by the Metropolitan Water and Sewerage Board, for laying 12,400 lin. ft. of c.-i. water pipe in Boston and Brookline, Mass. Henry H. Sprague is Chn., Dexter Bracket is Ch. Engr. Water Wks., 1 Ashburton Pl., Boston

CAMBRIDGE, MASS.—Bids are asked by the city until noon, Aug. 20, for furnishing the Water Board with about 500 meters. Edwin C. Brooks is Supt.

BOSTON, MASS.—The LOCKWOOD MFG. CO. has secured the contract at $23,500, for repairing engines Nos. 3 and 4 at the pumping station, Calf Pasture.

MONTAGUE, MASS.—The State Board of Health, Boston, has approved the plans for the Lake Pleasant water supply district in this town. A system of pipes will be laid to Lake Pleasant village, the pressure to be furnished by the Turner Falls system.

*YONKERS, N. Y.—We are officially advised that the CAMDEN IRON WORKS has been awarded the contract for furnishing and delivering on the public dock here before Oct. 1, 1908, 1,000 lengths of 8-in. B. & S. c.-i. pipe, weighing 625 lbs. per length, and 100 lengths of 4-in. pipe, weighing 280 lbs., at $7,117. Bids were opened on Aug. 17. James D. McIntyre is Secy. Bd.

CHAMBERSBURG, PA.—Bids are asked until 5 p. m., Aug. 24, by E. V. Frey, Council Clk., for the construction of a concrete dam and sidewalls.

PHILADELPHIA, PA.—Bids were received as follows on Aug. 15 by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for four boilers with superheaters and stokers, connecting flue and one self-supporting steel stack, for the Navy Yard, Philadelphia (Specification No. 1594): Edge Moor Iron Co., Edge Moor, Del., Item 2, 46,329, add $688, add $1,020, add $520, deduct $1,125, deduct $828; D'Olier Engineering Co., 121 S. 11th St., Philadelphia, Item, $52,460, 2, $50,560; Heine Safety Boiler Co., 1120 Pennsylvania Bldg., Philadelphia, Item 2, $46,477, $46,477, deduct $2,557; Oil City Boiler Works, 39 Cortlandt St., New York, Item 2, $53,463; Babcock & Wilcox Co., 1110 North American Bldg., Philadelphia, Item 1, $47,875, 2, $44,190, deduct $1,814, deduct $2,562; Oil Well Supply Co., 215 Water St., Pittsburg, Pa., Item 2, $59,400; A. D. Granger Co., 90 West St., New York, Item 1, $56,829, 2, $54,829.

*PHILADELPHIA, PA.—Bids are asked by George W. Stearns, Dir. Pub. Wks., until noon, Sept. 3, for apparatus for cleaning slow sand filters at the Upper and Lower Roxborough and Torresdale filters.

WILMINGTON, DEL.—Changes have been made in the plans prepared some time ago for the construction of slow sand filters, and bids may be asked about Sept. 1. The present plan is to have the contractor bid on the plans, this bid to be considered the cost price in any negotiation leading up to the purchase of the plant by the city, the contractor to furnish filtered water at a fixed price per 1,000,000 gallons, plus interest on the cost of the plant, until such time as the city may be able to sell bonds for the purchase. John A. Kienle is Ch. Engr., Water Dept.

BALTIMORE, MD.—Daniel W. Banks, Consulting Engr., Maryland Savings Bank Bldg., has been selected to prepare plans and specifications for the construction of a pipe line system in the business district. The plans will provide for a pumping station costing about $250,000, equipped with two distinct motive powers, and of sufficient capacity to give a pressure of 300 lbs. per sq. in. at nozzles. A complete system of pipes and hydrants will be installed, to cost about $250,000. The work will be under the supervision of the Board of Fire Commissioners, Edward M. Parrish, Pres., City Hall.

ANNAPOLIS, MD.—The McCAY ENGINEERING CO., Garner W. Denmead, Secy.-Treas., 9 East Lexington St., Baltimore, Md., has been awarded the contract for the extension of the water system at the U. S. Naval Academy here.

FREDERICK, MD.—The city is considering laying a 15-in. water pipe line parallel to the present 8-in. main. Estimated cost, about $10,000.

FT. McPHERSON, GA.—[illegible] are asked until Sept. 4 by Lieut. W. F[illegible] lliday, Constructing Q. M., U. S. A., fo[illegible] ing one or two 8-in. tubular wells at th[illegible] st.

OCILLA, GA.—The citizen[illegible] voted in favor of issuing $70,000 of[illegible] s for the construction of water-works.

*UNIVERSITY, ALA.—Bid[illegible] asked by the Building Committee of th[illegible] iversity of Alabama, University, until [illegible] Sept. 7, for the construction of a [illegible] te water-works system. Dr. John W[illegible] bercrombie is Pres., University, Ala.

FORT BARRANCAS, FL[illegible] lans and specifications are on file at th[illegible] ce of Engineering News, New York, [illegible] the construction of a 60,000-gallon [illegible] tank and for moving and reconstructi[illegible] eel tower here. Bids are asked until A[illegible].

CLARKSDALE, MISS.—Bids [illegible] asked until Aug. 24 by the Board of [illegible] emen for (a) constructing 250-000-gallo[illegible] ed reservoir; (b) constructing rein[illegible] d-concrete chimney; (c) 300-KW., 3-pha[illegible] ngine-type generator; and (d) 450-HP. [illegible] le Corliss or 4-valve engine for this g[illegible] tor. For specifications address Walter G[illegible] irkpatrick, Engr., Jackson, Miss. (Correc[illegible] em of incorrect notice appearing in [illegible] issue of Aug. 6.)

HARRISONBURG, LA.—Bids [illegible] asked by the Police Jury of Catahoul[illegible] rish until Oct. 5 for drilling a 4-in. arte[illegible] well. H. W. Bethard is Secy.

ROCKPORT, OHIO.—Bids ar[illegible] ked until Aug. 21 by William Dahm, [illegible] age Clk., for laying water mains in Mid[illegible] and Lakota Aves. Frank R. Lander, [illegible] 9 American Trust Bldg., Cleveland, Oh[illegible] is Engr.

TOLEDO, OHIO.—The Boa[illegible] of Public Service has entered into a cont[illegible] with the RIGGS & SHERMAN CO., Consu[illegible] ng Engrs., of Toledo, whereby the compa[illegible] will furnish a sanitary engineer to m[illegible] ke an investigation looking towards provi[illegible] ing a better municipal water supply.

*CINCINNATI, OHIO.—Bids are asked until noon, Sept. 1, by the Board of Public Service for cleaning c.-i pipe and special castings and valves in such streets as may be decided upon by the Board of Public Service, and other miscellaneous work in connection therewith, for the water distribution system of the city. John J. Wenner is Clk. Bd.

*ROCKVILLE, IND.—The time for receiving bids for water-works, plant to include brick pumping station, two vertical boilers, two horizontal duplex pumps of a capacity of 170 gallons per min. each and about 2½ miles of 6 to 8-in. c.-i. pipe, has been extended from Aug. 24 to Aug. 26. F. E. Strouse is Town Engr., Rockville. Dabney H. Maury is Consulting Engr., Peoria, Ill.

MUSKEGON, MICH.—Bids are asked by B. H. Tellman, City Recdr., until Sept. 8, for a vertical pump of 6,000,000 gallons capacity in 24 hrs., to be installed at the Lake Michigan pumping station.

OWOSSO, MICH.—Bids are asked until Aug. 26 by the Board of Public Works for furnishing and installing complete two Scotch-marine boilers of 200-HP. each for the water-works.

OAK PARK, ILL.—Bids are asked until 4 p. m., Aug. 20, by R. A. Carpenter, Comr. Pub. Wks., for the construction of a 16-in. c.-i. water supply pipe in North Boulevard.

NORTH CHICAGO, ILL.—Bids are asked until noon, Sept. 1, by the Bureau of Navigation, Navy Department, Washington, D. C., for a water supply intake, crib, pump well and auxiliary piping at the naval training station, Great Lakes, North Chicago. Specifications will be furnished and plans may be procured upon application to the Commandant, Naval Training Station, Great Lakes, North Chicago. J. E. Pillsbury is Ch. of Bureau.

CENTRALIA, ILL.—The F. M. PRESCOTT CO., Milwaukee, Wis., was awarded the contract on Aug. 5 by the City Council for installing a triple-expansion pump at the water-works plant, at $7,640.

EAST GRAND FORKS, MINN.—Loweth & Wolf, 20 First National Bank Bldg., St. Paul, Minn., are preparing plans for a complete water-works and filtration plant for this city. C. F. Zimmerman is City Clk. Estimated cost, $40,000.

KEEWATIN, MINN.—Bids are asked by the village until 3 p .m., Aug. 22, for the construction of a system of water-works. P. A. McEachin is Village Recdr.

COTTONWOOD FALLS, KAN.—Bids are asked until Aug. 26 by W. W. Sanders, City Clk., for furnishing the material and constructing a system of water-works. Estimated cost, $25,000. Burns & McDonnell are Engrs., Scarritt Bldg., Kansas City, Mo.

PILGER, NEB.—Bids are asked by C. A. Tinney, Village Clk., until Aug. 25, for constructing a system of water-works, water mains, suitable buildings and equipment. Estimated cost, $10,000.

FORREST CITY, ARK.—The city has voted to issue $30,000 of bonds to consolidate and improve the municipal water and light plants.

AUSTIN, TEX.—Walter G. Kirkpatrick, Consulting Engr., Jackson, Miss., is preparing plans for a reinforced-concrete pumping station for the municipal water-works here.

NORTH YAKIMA, WASH.—One mile of new water mains will be laid this year by the Northwest Light & Water Co.

NEWPORT, WASH.—Fleming [illegible] Randolph, Consulting Engrs., have [illegible] bmitted plans and estimates for diking and [illegible] mming that portion of the Kalispel Val[illegible] lying south of the Kalispel River. Th[illegible] district to be improved contains about 12,0[illegible] acres. It is estimated that the entire co[illegible] of the work, including the pumping plant will be about $27,255.

WINLOCK, WASH.—The village [illegible] as decided to establish a water system. E[illegible] mated cost, $15,000.

SEATTLE, WASH.—R. H. Thomson, City Engr., has reported the estimated cost of the following improvements: Fourth Ave., South and other streets, water-mains, $42,-100; E[illegible] Ave., South and other streets, water-[illegible] $64,800; 17th Ave., South, and other [illegible] water-mains, $24,800; Seventh Ave., [illegible], $5,600.

PORTLAND, ORE.—Bids are asked until Sept. 11 for furnishing the city 500 fire hydrants.

MESA CITY, ARIZ.—The city has voted $50,000 bonds for the installation of water-works. L. G. Knipe, Phoenix, Ariz., is Engr.

MARYSVALE, UTAH.—Bids are asked until 2 p. m., Sept. 1, by Thomas C. Callister, Secy. State Bd. Land Comrs., Salt Lake City, Utah, for the construction of a reservoir dam involving about 230,000 cu. yds. of earth work and 6,000 cu. yds. of rip-rap, a spillway involving about 120,000 cu. yds. of earth work, together with timber regulating gates therefor. The reservoir is to be constructed across the Sevier River, about ten miles south of Marysvale. Three alternative bids will be received for the construction of this dam and the State of Utah reserves the right to accept either alternative bid. In the specifications these three alternatives come under the following heads: (1) Ordinary earth fill; (2) hydraulic fill core; (3) hydraulic fill dam. Plans and specifications may be seen at the office of the Secretary of the State Board of Land Commissioners, Salt Lake City, or at the office of H. N. Hayes, Comr., Richfield, Utah.

OTTAWA, ONT.—The contract for the construction of a dam above the Chaudiere Falls, to increase the water-power, has been let to QUINLAN & ROBERTSON, Contractors, of Montreal, at $250,000.

SEWERAGE.

(* *denotes that this work is advertised in Engineering News.*)

BATH, ME.—The contract for the construction of about 7,000 ft. of sewers was awarded on Aug. 10 by the Street and Sewer Commission to the HANSCOM CONSTRUCTION CO., 1102 Exchange Bldg., Boston, Mass., at about $26,000.

ST. ALBANS, VT.—Bids are asked until noon, Aug. 31, by the Mayor and Board of Aldermen for constructing sewers and appurtenances. N. N. Atwood is Mayor.

THOMPSONVILLE, CONN. — Bids are asked by the Board of Sewer Commissioners for the construction of 1.300 ft. of 6-in., 1,400 ft. of 8-in., 1,150 ft. of 10-in., and 2,000 ft. of 12-in. pipe, 20 manholes and three flush tanks until noon, Aug. 25. M. W. Bushnell, Thompsonville, is Secy. Bd.

HARTFORD, CONN.—Bids are asked by the Board of Contract and Supply until 11 a. m., Aug. 24, for the construction of 140 lin. ft. of 12-in. sewer in Asylum Ave. James P. Berry is Secy. Bd.

BRIDGEPORT, CONN.—The Pierce Mfg. Co., 95 Wall St., submitted the lowest bid on Aug. 5 for laying 4,000 ft. of sewer in Fairfield Ave. at the following bid: $1.68 a ft. for 14 × 21-in. pipe; $1.29 a ft. for 10 × 19-in.; $3.85 per cu. yd. for rock excavation; $3.50 per ft. for manholes; $37.50 each for sewer wells.

GATES, N. Y.—Six bids for the construction of a sewer in Jay St., from the Field road to the West Side sewer here were opened on Aug. 13 at the office of W. R. Storey, Town Engr. The bids were as follows: William Fuller, $20,936; Whitmore, Rauber & Vicinus, $23,058; F. C. Lauer & Sons Co., $23,365; Brayer & Albaugh, $24,-241; Denniston & Co., $25,721; H. B. Hooker & Sons, $26,434.

FULTON, N. Y.—See under Streets and Roads.

BRONXVILLE, N. Y.—On Aug. 4 the Board of Trustees opened bids for the construction of Bronxville's part of the Tuckahoe-Bronxville joint sewer and for the Vine St. sewer. The bids were as follows: Briggs & McLaughlin, $6,322; Antonio Miele, $12,-200; Charles Mattolo, $6,775; Charles Marra, $5,096; Pasquale Cestone, $7,900; FRANK CESTONE, $4,112 (awarded contract); Luigi Merone, $6,200.

BROOKLYN, N. Y.—Bids are asked until 11 a. m., Sept. 2, by Bird S. Coler, Boro. Pres., for furnishing all the labor and material required for constructing a sewer in Prospect Pl., from Hopkinson Ave. to Eastern Parkway.

FT. LEE, N. J.—Bids are asked by the Mayor and Council until Aug. 21 for the construction of a portion of Dead Brook sewer. John C. Abbott is Mayor. Ralph D. Earle, Jr., of Hackensack, N. J., is Engr.

HACKENSACK, N. J.—Bids are asked until Sept. 8 by the Hackensack Improvement Commission, C. Linkroum, Pres., Union St., Hackensack, for constructing the Poplar Ave. sewer.

POINT PLEASANT, N. J.—Bids are asked until Sept. 3 by the Mayor and Borough Council for furnishing material and constructing a system of sewers and drains, in all about four miles of 6 to 12-in. vitrified pipe.

NORTH BRADDOCK, PA.—Bids are asked until 3 p. m., Sept. 4, by C. A. Stewart, Boro. Engr., Municipal Bldg., for the construction of a sewer in Maple Ave.

DUNMORE, PA.—The ENGINEERING & CONSTRUCTION CO., of Scranton, Pa., has secured the contract for a sewer in Quincy Ave.

*FREEPORT, PA.—Bids are asked until 7.30 p. m., Aug. 24, by the Burgess and Council of Freeport Borough, Freeport, for grading, curbing, paving and sewering part of Market St. and part of Sixth St.; also for the sewering of part of Stewart St. and part of Washington St. and part of Third St.; also for extending outlet of Fifth St. sewer. H. L. Kiskaddin is Boro. Clk.

*WASHINGTON, D. C.—Bids are asked by the Commissioners of the District of Columbia until noon, Sept. 14, for constructing Section C of the East Side intercepting sewer, boundary to Brookland.

WASHINGTON, D. C.—Bids were received as follows on Aug. 17, at the office of the Commissioners of the District of Columbia, for the construction of two sewers: (a) R. J. Beall Construction Co., (b) Warren J. Beenizer Co., (c) James A. Coyle, (d) E. G. Gummel, all of Washington, D. C. New Hampshire Ave. sewer: Ordinary excavation, (a) 74 cts., (b) 85 cts., (c) 69 cts., (d) 78 cts.; sewer brick masonry (a) $15, (b) $15, (c) $18, (d) $15; 21-in. pipe, (a) 99 cts., (b) $1.10, (c) $1.10, (d) $1.05; 18-in. pipe, (a) 89 cts., (b) 95 cts., (c) $1, (d) $1; 12-in. pipe, (a) 70 cts., (b) 75 cts., (c) 79 cts., (d) 78 cts.: Arkansas Ave. sewer: Ordinary excavation, (a) 65 cts., (b) 80 cts., (c) 68 cts., (d) 78 cts.; sewer brick masonry, (a) $13.50, (b) $15, (c) $16, (d) $14; 12-in. pipe, (a) 70 cts., (b) 70 cts., (c) 69 cts., (d) 78 cts.

BIRMINGHAM, ALA.—Julian Kendrick, Consulting Engr., Birmingham, is preparing plans for a storm and sanitary sewerage system for which bond issue of $400,000 was voted in May. Total expenditure will be about $800,000.

FORNEY, ALA.—The city will soon have plans prepared for the construction of the sewer system, for which bonds have been voted.

COLUMBIA, MISS.—The city has awarded the contract to the SOUTHERN SEWER PIPE CO., Birmingham, Ala., for furnishing pipe to be used in the construction of the sewer system, the contract for which has been awarded to BOSLER & FLYNN, Chattanooga, Tenn.

NEW ORLEANS, LA.—Bids are asked until Sept. 1 by the Sewerage & Water Board for furnishing sewer pipe, lumber, brick, sand, cement, gravel, etc., for the use of the Board in sewer construction.

KNOXVILLE, TENN.—ENGERT & HOUSE of Knoxville have secured the contract at 47 cts. per lin. ft. for constructing an 8-in. sewer lateral from the First Creek main sewer extension.

DAYTON, KY.—The City Council on Aug. 10 opened bids for trunk sewers along and under Vine, Main and McKinney Sts. There were five bidders as follows: Walter Bros., of Dayton, $46,136 for a brick sewer and $38,499 for concrete; Stack & Co., $39,313.75 for brick, $35,762.20 for concrete; Bacus & Co., of Dayton, Ohio, $48,620 for concrete, $36,426.20 for brick; McLane & Bros., of Newport, Ky., $41,114 for brick, $36,477 for concrete; the DOUGLASS HEATING & PLUMBING CO., of Cincinnati, Ohio, $35,-427 (awarded contract).

NEWARK, OHIO.—Bids are asked until noon, Aug. 26, by the Board of Public Service for the construction of a tile sanitary and drainage sewer. Albert C. Gundlach is Clk. Bd.

FORT WAYNE, IND.—Bids are asked until 7.30 p. m., Aug. 27, by the Board of Public Works for the construction of a brick sewer. H. W. Becker is Clk. Bd.

KENDALLVILLE, IND.—Bids for the construction of the sewer work estimated to cost about $14,000 will be asked about the last of this month. Willis E. Sawyer, of Albion, is Engr. William P. Myers is City Clk.

PONTIAC, MICH.—LENANE BROS. have been awarded the contract at $3,025 for the construction of a sewer in South Saginaw St.

ISHPEMING, MICH.—Johnson & Munson, of Ispeming, are the lowest bidders for the construction of a sewer in the Sixth Ward, at $9,594. The next lowest bid was that of E. R. Harding, of Racine, Wis., at $12,644. The other bids were as follows: Charles Johnson, Oshkosh, Wis., $14,078; Pastoret & Lunz, Duluth, Minn., $13,018; William Trebilcock, Ishpeming, $14,367; Northern Construction & Engineering Co., Escanaba, Mich., $13,551; Robert R. French, Marquette, Mich., $14,781.

PEORIA, ILL.—Bids will be asked about Sept. 15 for the construction of the North End sewer. Estimated cost, about $230,000. Isaac J. Levinson is Secy. Bd. of Local Improvements.

SIOUX CITY, IOWA.—Bids are asked until Aug. 25 at the office of the City Clerk, for furnishing material and constructing sewers in portions of several streets.

G. Y. Skeels, City Engr., has prepared plans for the Bacon Creek sewer providing for brick and concrete construction. The conduit is to be 2,500 ft. long, and if constructed of brick is to be 4-ring. Estimated cost, $54,445.

CROOKSTON, MINN.—The City Engineer has estimated the cost of constructing sewers in portions of Alexander St. and Summit and River Aves. at $4,605.

SAUK CENTER, MINN.—Bids are asked by J. F. Cooper, City Clk., until Aug. 28, for constructing a district sewer, requiring 1,452 ft. of 8-in. and 1,844 ft. of 10-in. sewer pipe, all necessary manholes, flush tanks, etc.

DULUTH, MINN.—Bids are asked until 10 a. m., Aug. 21, by the Board of Public Works for the construction of a sanitary sewer. Estimated cost, $8,000. R. Murchison is Clk. Bd.

WASECA, MINN.—Bids are asked until 8 p. m., Aug. 25, by John Madigan, City Clk., for constructing sewers as follows: A reinforced-concrete septic tank and appurtenances; 1,905 lin. ft. of 12-in. sewer, 500 lin. ft. of 10-in. sewer, 1,865 lin. ft. of 8-in. sewer, together with 15 manholes and other appurtenances. Loweth & Wolff are Engrs., St. Paul, Minn.

ABERDEEN, S. DAK.—JAMES KENNEDY of Fargo, S. Dak., has been awarded the contract by the city for constructing the East Side sewer system at $28,311. List of bidders noted last week. D. C. Washburn is City Engr.

MELLETTE, S. DAK.—Bids are asked until 8 p. m., Aug. 24, by A. W. Jeffries, City Audr., for constructing a sewer system here.

SEDALIA, MO.—The contract for constructing a sewer in sewer district No. 41, bids opened on Aug. 3, has been awarded to DEAN BROS., of Sedalia, at about $9,000. C. E. Baker is City Clk.

*PAUL'S VALLEY, OKLA.—Bids are asked until 4 p. m., Aug. 27, by L. W. Wettermark, City Clk., for the construction of a sanitary sewer (5.8 miles of 10, 12 and 15-in. vitrified pipe.)

DURANGO, COLO.—Bids are asked until 9 a. m., Aug. 28, by H. R. Scouton, Mayor, for the construction of twelve sanitary sewers and appurtenances.

SEATTLE, WASH.—R. H. Thomson, City Engr., has reported the estimated cost of the following improvements: West 56h St., and other streets, sewers, $4,000.

LIMOILOU, QUE.—Bids for the construction of the sewerage system are asked until 8 p. m., Aug. 25. J. E. Chapleau is Secy.-Treas. Ouimet & Le Sage are Ch. Engrs., 21 St. James St., Montreal, Que.

DELORIMIER, QUE.—The Town Council has awarded the contract for the completion of sewers here to J. D. LATOUR. The work is to be done between now and the month of December.

GARBAGE DISPOSAL.

READING, PA.—Bids are asked until 7 p. m., Aug. 28, at the office of the City Clerk for the collection, removal and disposal of all garbage and offal for the period of three and five years. Elmer H. Beard is City Engr.

PASADENA, CAL.—The City Council has approved an ordinance providing for the construction of a garbage crematory. Herman Dyer is City Clk.

STREETS AND ROADS.

(* *denotes that this work is advertised in Engineering News.*)

CONCORD, N. H.—Bids are asked until 5 p. m., Aug. 25, by A. W. Dean, State Engr., Concord, for grading and surfacing with gravel, a portion of the Merrimack Valley road, town of Hookset, and grading and surfacing a portion of the same road, in the town of Boscawen, a portion to be surfaced with trap rock and the remainder with gravel.

HARTFORD, CONN.—Bids for the construction of State roads are asked at the office of the State Highway Commissioner, Capitol, until 2 p. m., Aug. 24, as follows: Town of Windsor Locks, 4.730 lin. ft. of macadam on the Hartford-Springfield turnpike; Town of New Canaan, 3,657 lin. ft. of macadam on Forest St.; Town of Westbrook, 9,000 lin. ft. special treatment on the Hartford-Saybrook turnpike; Town of Stratford, 3,116 lin. ft. macadam on Barnum Ave.; Town of Rocky Hill, 7,100 lin. ft. macadam on the Hartford-Berlin turnpike, six 24-in. tile culverts called for; Town of Washington, 2,500 lin. ft. macadam, one 18-in. tile culvert called for; Town of Meriden, 900 lin. ft. of rubble drain and macadam road on the North Colony road; Town of Wethersfield, 11,125 lin. ft. macadam on the Hartford-Berlin turnpike, four 20-in., four 24-in., one 30-in., and one 18-in. tile culverts called for; Town of Ashford, five sections of grading, aggregating 2,673 lin. ft. and 1,100 ft. telford, four 18-in., two 20-in. and one 24-in. tile culverts called for.

HARTFORD, CONN.—The following contracts for state road work, bids for which were opened on Aug. 11, have been awarded by the State Highway Commissioner:

Town of Avon, 2,325 lin. ft. of macadam-telford, on the Simsbury road, to A. C. STERNBERG & SON, West Hartford, $2,-935. Other bidders were: Amos Bridges' Sons, Hazardville, $3,220; Connecticut Contracting Co., Middletown, $3,304; Lane Construction Co., Meriden, $3,520; Joseph Mascetti, Torrington, $3,861; T. F. Foley, South Norwalk, $3,499; F. Arrigoni & Bro., Durham, $4,490; O. T. Benedict, Pittsfield, Mass., $4,024; Olmsted & Olmsted, East Hartford, $3,627.

Town of Avon, 5,645 lin. ft. of macadam-telford, on the Hartford-Albany turnpike, to the CONNECTICUT CONTRACTING CO., Middletown, at $6,889. Other bidders were: Lane Construction Co., $7,186; Joseph Mascetti, $10,908; T. F. Foley, $8,524; A. C. Sternberg & Sons, $8,072; F. Arrigoni & Bro., $11,177; O. T. Benedict, $8,879; Olmsted & Olmsted, $9,484; one 24-in. and one 15-in. tile pipe culverts are required on this contract.

Town of Bristol, 969 lin. ft. of macadam and 375 lin. ft. of telford, on Center St., to PIERSON ENGINEERING & CONSTRUCTION CO., Bristol, Conn., at $1.25 for macadam and $1.75 for telford. Other bidders were: Joseph Mascetti, $1.90 and $2.50; A. C. Sternberg & Sons, $1.32 and $1.74.

Town of Simsbury, 5,639 lin. ft. of macadam-telford, 1,920 lin. ft. of wall, railings and bridge abutment, to the CONNECTICUT CONTRACTING CO. (lump sum), $11,886, with extra for cobble gutters, railings and telford. Other bidders were: A. Brazos & Sons, Middletown, $2.80 for macadam; $3.30 for telford; $2,997 for wall and $1,400 for bridge abutment; Amos Bridges' Sons, Hazardville, $3.24; $3.84; $2,990 and $1,000; T. F. Ley Co., Springfield, Mass., $4.10; $4.35; $3.107 and $300.

Town of Windsor, two sections aggregating 4,800 lin. ft. of macadam-telford, to the CONNECTICUT CONTRACTING CO., Middletown, at $8,974. Other bidders were: A. Brazos & Sons, $9,611; Amos Bridges' Sons, $11,181; Lane Construction Co., $1,068; Thomas Kearney, Meriden (one section only), $8,260; one 15-in. tile culvert required on this work.

NEW HAVEN, CONN.—The RUDOLPH S. BLOME CO., 79 Dearborn St., Chicago, Ill., has been awarded the contract for paving with concrete portions of Fair and Chapel Sts., at $3,469 and $12,710, respectively. Bids were opened on Aug. 6.

ROCHESTER, N. Y.—The Board of Contract and Supply awarded contracts on July 29 for paving as follows: To F. C. LAUER & SONS, 458 South Clinton Ave., with brick, Delaware St., at $4,255, and Mt. Vernon St., at $7,300.

NEW YORK, N. Y.—Bids are asked by the Park Board until 3 p. m., Aug. 27, for constructing cement curb and sidewalks around the park at Westerleigh, in the Borough of Richmond, city of New York. Henry Smith is Pres. Bd.

NEW YORK, N. Y.—The following bids were opened on Aug. 4 at the office of Louis F. Haffen, Pres. Bronx Boro., for repaving with asphalt block and with granite blocks on a concrete foundation Boston Road, from Southern Boulevard to Tremont Ave.: (a) Barber Asphalt Paving Co., 30 Church St.; (b) Hastings Pavement Co.; (c) Asphalt Construction Co., Madison Ave. and 137th St.; (d) Continental Asphalt Paving Co., 42 Broadway: 1,100 sq. yds. new granite block pavement on a concrete foundation, laid with paving cement joints, (a) $3.19, (b) $3, (c) $3.35, (d) $3.40; 2,570 cu. yds. concrete, (a) $6, (b) $5.60, (c) $6.10, (d) $5.92; 2,000 lin. ft. new curb, (a) 98 cts., (b) $1, (c) 95 cts., (d) 99 cts.; 2,050 lin. ft. old curb, rejointed and reset, (a) 38 cts., (b) 45 cts., (c) 38 cts., (d) 42 cts.; 290 sq. ft. old bridgestone, rejointed and relaid, (a) 30 cts., (b) 28 cts., (c) 30 cts., (d) 30 cts.; 12,065 sq. yds. completed asphalt block pavement, to keep same in repair for five years, (a) $1.97, (b) $2.03, (c) $2.12, (d) $2.17; 200 cu. yds. rock excavation, (a) $4.50, (b) $7, (c) $10, (d) $3; 5,115 sq. yds. completed asphalt block pavement, not to be kept in repair, (a) $1.86, (b) $2.03, (c) $1.98, (d) $2.07. Totals, (a) $55,937, (b) $56,971, (c) $59,833, (d) $59,251.

TROY, N. Y.—Bids are asked until Aug. 21 by the Board of Contract and Supply, James M. Riley, Secy., for grading and regulating Ave. B and constructing a culvert from Ninth to 15th Sts.

FULTON, N. Y.—Bids are asked until Aug. 24 by the Board of Public Works for curbing and paving Cuyuga St.; curbing and paving and constructing a storm sewer in a portion of Oneida St.; and a storm sewer in a portion of Third St. W. A. Harrison is City Clk.

JOHNSTOWN, N. Y.—All bids opened on Aug. 3 for paving, curbing, etc., North Perry St., have been rejected and new bids will probably be received about Aug. 31. The former quantities included in the work were: 11,164 sq. yds. Clearfield brick pavement; 4,826 lin. ft. of new stone curb; 567 lin. ft. of new stone headers; 152 lin. ft. of 6-ft. radius curb; 80 new driveway corners; 1,125 cu. yds. of extra excavation in railroad track; 632 cu. yds. of broken stone in railroad track. Frank Bogaskie is City Clk.

GLENS FALLS, N. Y.—Bids are asked at the office of H. G. Potter, City Clk., until Aug. 24, for 6,352 sq. yds. of sheet asphalt pavement on Portland cement concrete foundation on Warren St.

LONG ISLAND CITY (L. I.), N. Y.—The contract for regulating, grading and paving with asphalt block on a concrete foundation Onderdonk Ave., from Elm St. to Stanhope St., 850 ft., was awarded on July 11 by George Cromwell, Pres. Borough of Queens, to the BARBER ASPHALT PAVING CO., 30 Church St., at $1,618.

The CONTINENTAL ASPHALT CO., 79 Wall St., has been awarded contract for laying sidewalks and paving with asphalt block on a concrete foundation, Academy St., from Freeman Ave. to Wilbur Ave., Long Island City, at $9,315.

*NEWBURG, N. Y.—Bids were received as follows by the City Council on Aug. 10 for resurfacing North Water St., from the south side of South St. to the south side of Broad St., to connect with the paving already done on either end: M. R. Spino, Fishkill Landing, N. Y., Pennsylvania Clay Co. brick, $13,375; Mack brick, $14,517. M. J. Dwyer, Newburg, Pennsylvania clay, $13,847; Clearfield clay, $13,619; Mack brick, $14,989. Nolan & Horning, Hoboken, N. J., Pennsylvania clay $14,167; Mack, $16,678. John M. Holler, Albany, N. Y., Pennsylvania, $15,079; Mack, $15,555; Standard brick, $15,402. Bulderry Bros., Albany, Pennsylvania, $15,-948; Clearfield, $15,187; Mack, $16,252; Cowan's brick, $14,806. George H. Gifford, Jamaica (L. I.), N. Y., Clearfield, $16,246; Mack, $17,238; Pittsburg-Buffalo Co. brick, $15,628; Shawmut brick, $16474. It was decided by the Committee to recommend the awarding of the contract to M. R. Spiro, at $13,375, the material used to be Pennsylvania brick. D. J. Coutant is City Clk.

JAMESTOWN, N. Y.—Bids are asked by the Board of Estimate and Review until 2 p. m., Aug. 21, for the construction of a pavement on Lake View Ave., 116,000 yds. paving and 6,000 lin. ft. curbing.

BROOKLYN, N. Y.—Bids are asked by Bird S. Coler, Boro. Pres., until 11 a. m., Sept. 2, for regulating, grading and repaving with asphalt, asphalt block and granite pavement on a concrete foundation certain streets; also regulating, grading, curbing and laying sidewalks on 57th St., from Twelfth Ave. to New Utrecht Ave.

*PHILLIPSBURG, N. J.—We are officially advised that bids were received by the Road Committee of the Board of Chosen Freeholders on Aug. 14 for the following roads in said county, known as the Morris Turnpike and the New Brunswick Turnpike, the former beginning at the Lopatcong Township line and extending to Filmore St., a distance of 6,179 ft.; the latter beginning at the end of the brick pavement on South Main St., Phillipsburg, and extending to the Pohatcong Township line, a distance of 3,966 ft. The lowest bidders were: Morris Turnpike, G. M. Frech, $9,796; New Brunswick Turnpike, Miles Tighe Contracting Co., $8,935. Joseph R. Thatcher is Dir. Bd.

*MONTVALE, N. J.—Bids are asked until 8.30 p. m., Aug. 28, by the Mayor and Council of Park Ridge Borough and Montvale Borough at Linderman's Hall, Montvale, N. J., for macadamizing of Grand Ave., a distance of 5,820 ft. Engineer's estimate of quantities are as follows: 5,203 cu. yds. earth excavation, 7,760 sq. yds. of macadam. John B. Hering is Boro. Clk., Montvale.

RED BANK, N. J.—The contract for constructing stone sidewalks on Branch Ave. and South St. has been awarded to MANSON & SON, at 11¾ cts. per sq. ft.

NEWARK, N. J.—PHILIP and PETER JOHNSON have been awarded the contract at $16,476, for paving Ridge St.

The NEWARK PAVING CO. secured the contract, at $6,545, for paving North 14th St.

NEWARK, N. J.—Bids are asked until Aug. 20 by the Board of Street and Water Commissioners for paving on South 14th St., requiring 4,600 sq. yds. of wood block pavement on a 6-in. concrete foundation, 3,000 lin. ft. 16 × 5-in., 4-cut curb, set in concrete, etc. Morris R. Sherred is Ch. Engr.

JERSEY CITY, N. J.—The contract for constructing three sections of the Hudson County Boulevard, bids opened July 30, has been awarded by the County Boulevard Commission to WILLIAM BAKER, 137 South St., Jersey City, as follows: Bayonne section, about 39,000 sq. yds. tar macadam, etc., $16,900; Jersey City section, about 36,000 sq. yds. tar macadam, $14,100; and Weehawken section, about 2,000 sq. yds. tar macadam, 3,500 sq. yds. gutter repaired, 4,000 ft. curb reset, $6,925.

The contracts for concrete curb and gutter on the Bayonne and Jersey City sections was awarded to the CARRINGTON CONSTRUCTION CO., Grand and Prior Sts., Jersey City, at $13,320 and $12,464, respectively. J. C. Sweeney is Clk.

ALTOONA, PA.—The Board of Public Works decided on Aug. 7 to readvertise the paving contracts which some time ago were let to Bowman Bros., of McKeesport, which firm has failed to execute the contracts.

BRADDOCK, PA.—Bids are asked until 8 p. m., Aug. 24, by the Council, for grading, paving and curbing Oak Grove Ave., from Aurelius St. to the borough line. E. M. Watt is Supt. Pub. Wks.

PITTSBURG, PA.—The County Commissioners on Aug. 4 awarded contracts for constructing the following roads: Monroeville and Pitcairn connecting road, to the McLAUGHLIN CONSTRUCTION CO., $15,583; Millers Grove and Clairton Road, to W. W. KELLY, 502 Fifth Ave., Pittsburg, $111,400; to COLLINS-GORDON CO., 407 Fourth Ave., Pittsburg, contracts were awarded for the Broughton and Cochrane Road, at $45,903; the Monroeville and Trestle Road, at $48,055; and the Brighton and Library connecting road at $32,192. G. T. Barnsley is County Road Engr.

WAYNESBURG, PA.—The contract for paving with brick about 11,000 sq. yds., bids opened on Aug. 5, has been awarded to the HALLAM CONSTRUCTION CO., of Washington, Pa., at $30,000. W. H. Sutton is Boro. Secy.

WASHINGTON, D. C.—Bids are asked until Aug. 22 by the Commisioners of the District of Columbia for paving the roadway of the Anacostia bridge and the roadway of the bridge across the Baltimore & Ohio R. R. tracks on the line of the extension of Monroe St., Anacostia, with sheet asphalt.

LEBANON, VA.—Bids are asked until Aug. 20 by the county for constructing ten miles of macadam roads. R. G. Fletcher is County Clk.

NORFOLK, VA.—The City Council has appropriated $8,270 for paving Henry St., Fourth Ward, and $2,849 for curbing and guttering Jamison and Ferguson Aves., Brambleton Ward.

GRAHAM, N. C.—Alamance County has voted $200,000 of bonds for road improvements and extensions.

ROME, GA.—The Georgia Engineering & Construction Co., of Rome, has submitted the lowest bid, at $103,502, for paving streets with vitrified brick. The work will embrace about 12,000 cu. yds. of excavation, furnishing and setting 12,000 lin. ft. of granite curb, and concrete foundations and surfacing 41,000 sq. yds. of pavement. Hazlehurst & Anderson are Engrs., Candler Bldg., Atlanta, Ga.

JACKSONVILLE, FLA.—The GEORGIA ENGINEERING CO., of Augusta, Ga., has secured the contract for paving Fourth St. and Myrtle Ave., about 10,000 sq. yds. of brick paving and 5,500 lin. ft. of stone curb, at $7.51½ per sq. yd. Philip Prioleau is City Engr.

WEST TAMPA (Tampa post-office), FLA.—The city will pave the streets and the Board of Bond Trustees has awarded contract to the SOUTHERN CLAY MFG. CO., First National Bank Bldg., Chattanooga, Tenn., to furnish 5,000,000 vitrified street-paving brick.

SELMA, ALA.—The city has awarded the contract to CROCKETT PAVING CO., Birmingham, Ala., at $48,647, for paving seven blocks on Water St. with vitrified brick, and to the MEMPHIS ASPHALT & PAVING CO., Memphis, Tenn., at $33,979, for paving three blocks on Broad St. with asphalt. Julien Smith is City Engr.

*DECATUR, ALA.—Bids are asked until Sept. 14 by W. E. Skeggs, Judge of Probate, for constructing a system of macadam roads. About $240,000 will be expended. Plans and specifications for the first 30 miles will be ready after Sept. 1.

*SCRANTON (Pascagoula post-office), MISS.—Bids are asked by the Mayor and Board of Aldermen at the Mayor's office until 9 a. m., Sept. 2, for furnishing materials and constructing approximately 100,000 sq. ft. concrete sidewalk; 20,000 lin. ft. concrete combined curb and gutter and the necessary crossings and culverts. For specifications and blank forms, address J. D. Clark, Chn. City Improvement Com., Scranton, Miss., or Walter G. Kirkpatrick, Engr., Jackson, Miss.

XENIA, OHIO.—The contract for constructing about two miles of Hargrave Road in Jefferson Township, bids opened on Aug. 8, has been awarded to HERBERT NAST, of Xenia, at $5,046. William Dodds is County Audr.

LOWELLVILLE, OHIO.—Bids are asked until Aug. 24 by George P. Schrader, Village Clk., for furnishing the material and macadamizing a portion of Walnut St., and for constructing all natural and artificial stone sidewalks that may be needed during the year 1908.

COLUMBUS, OHIO.—Bids are asked until Aug. 28 by the Board County Commissioners for a permanent roadway on the superstructure of the Central College bridge over Big Walnut Creek in Blendon Township, as per engineer's estimate No. 933. John R. Scott is County Clk.

BYESVILLE, OHIO.—The contract for paving Main and Depot Sts., bids opened on July 30, has been awarded to PUTNAM & PRICE, of Marietta, Ohio, for all work, excepting the furnishing of the brick for the pavement, at $13,058. The work includes 3,008 cu. yds. excavation, 6,473 lin. ft. straight curbing, 304 lin. ft. 10-ft. radius curbing, 208 lin. ft. 5-ft. radius curbing, 420 lin. ft. protection curb, 14 catch basins, 5 manholes, 415 lin. ft. 15-in. and 420 lin. ft. 12-in. sewer pipes, 5,000 lin. ft. 4-in. tiling and laying 10,024 sq. yds. of brick paving.

The NOBLE BRICK CO., of Glenwood, Ohio, secured the contract for furnishing the brick, about 10,024 sq. yds., at $6,014. O. M. Hoge, of Cambridge, Ohio, is Engr.

DEFIANCE, OHIO.—Bids are asked by the Board Public Service until Sept. 1 for paving a portion of North Clinton St., with brick paving block on a concrete base. Michael J. Walz is Clk. Bd.

COLUMBUS, OHIO.—W. C. WOOLEY & CO., of Marion, Ohio, have secured the contract, at $12,167, for constructing a state road in Franklin County.

CINCINNATI, OHIO.—Bids are asked by the County Commissioners until noon, Sept. 4., for repairing Blue Ash Ave., from Cooper Ave. to Plainfield Pike, and Plainfield Pike, from Blue Ash Ave. to Montgomery Pike, Sycamore Township. Fréd. Dreihs is Clk. Bd.

*SHELBY, OHIO.—Bids are asked by the Council until noon, Aug. 26, for draining, curbing, grading and constructing a macadamized road upon the Boulevard and Wentz Ave. in the village. The improvements aggregate about ¾ of a mile in length. Estimated cost, about $10,000.

LAFAYETTE, IND.—Bids are asked by the Commissioners of Tippecanoe County until 10 a. m., Sept. 10, for the construction of a gravel road in Tippecanoe and Wabash Townships. John P. Foreman is Audr.

EAST ST. LOUIS, ILL.—The following bids were received on Aug. 11 by the city for street paving: Missouri Ave.: Fruin-Colnon Contracting Co., $40,560; MYERS CONSTRUCTION CO., Third National Bank Bldg., St. Louis, Mo., $33,166 (awarded contract); Skrainka Construction Co., $38,213; Walter Coonan, $43,711; W. H. Hill, $33,938; Keely & Gaynard, $36,778; Giesel Construction Co., $39,294; engineer's estimate, $39,347; Second St.: Keely & Gaynord, $10,409 (banner brick); Geisel Construction Co., $11,828 (banner); MYERS CONSTRUCTION CO., $9,568 (banner), $9,568 (Alton brick) (awarded contract); Walter Coonan, $11,064 (banner); W. H. Hill, $10,497 (banner); engineer's estimate, $11,382.

*EUREKA, ILL.—We are officially advised that the lowest bid received on Aug. 12 by the city for the construction of about 1,400 lin. ft. of cement curb and laying of cement curb and laying about 8,000 sq. yds. of brick paving (gravel foundation with cement filler) was that of William Thatcher & Co., at $1.58 per sq. yd. H. S. Reynolds is City Clk.

FOND DU LAC, WIS.—Bids are asked until 3 p. m., Sept. 5, by the Board of Public Works for furnishing all material and doing all the work necessary and required to improve Military and Union Sts., from Western Ave. to the east branch of the Fond du Lac River, to the established grade, by grading the roadway and constructing a cement pavement consisting of a 5-in. Portland cement foundation with a 1½-in. wearing surface as hereinafter specified under a five-year guarantee, together with a Portland cement combined curb and gutter. Plans, profiles, details and specifications may be seen at the office of the City Clerk.

The contract for paving about 10,000 sq. yds. on South Main St. was awarded on Aug. 4 to the McARGO CONSTRUCTION Co., of Fond du Lac, at $16,941. J. F. Honensee is City Clk.

APPLETON, WIS.—All bids received on July 27 for paving Lake St. have been rejected and new bids are asked until Aug. 31. McClellan Dodge, is City Engr.; E. L. William is City Clk.

OSCEOLA, IOWA.—Bids are asked by W. N. Temple, City Clk., until Sept. 7 for about 6,500 sq. ft. of cement sidewalk.

MANKATO, MINN.—Bids are asked until 2 p. m., Sept. 7, by the County Auditor for constructing the Rapidan Mills Hill road.

*CANEY, KAN.—Bids are asked until 5 p. m., Sept. 1, by Mary E. McMillan, City Clk., for paving, guttering and bringing to grade certain portions of Fourth Ave., Spring and State Sts., about 21,780 sq. yds. of brick paving.

FORT MACKENZIE, WYO.—Bids are asked until 10 a. m., Sept. 5, by Lieut. L. E. Hohl, Constructing Q. M., U. S. A., for macadam roads, curbs, drains and gutters at this post.

ST. LOUIS, MO.—The Board of Public Improvements has awarded paving contracts as follows: Minnesota St., WILLIAM R. BUSH CONSTRUCTION CO., Holland Bldg., $10,766; Gano St., JAMES T. McMAHON, $9,041; Hull Place, WEBB-KUNZE CONSTRUCTION CO., Fullerton Bldg., $3,380; Humphrey St., GUSTAVUS A. HEMAN, Holland Bldg., $15,082; Maffitt St., HANICK QUARRY & CONSTRUCTION CO., Liggett Bldg., $13,044; Brannon St., WEBB-KUNZE CONSTRUCTION CO., $19,708; Pulaski St., G. EVERMANN & BRO., 5100 Virginia St., $4,707; Third St., WEBB-KUNZE CONSTRUCTION CO., $11,186; Oregon St., G. EYERMANN & BRO., $5,485; Lambdin St., HANICK QUARRY & CONSTRUCTION CO., $6,755; Lambdin St., HANICK QUARRY & CONSTRUCTION CO., $10,490; Sullivan St., WILLIAM H. REDEMEYER, North Ninth St., $12,756; Juniata St., WILLIAM R. BUSH CONSTRUCTION CO., $24,317; Eighth St., from Franklin to Biddle St., HEMAN CONSTRUCTION CO., $9,288. All of the above streets except Eighth St. are to be paved with brick. Eighth St. is to be paved with granite.

Bids are asked until Aug. 21 by the Board Public Improvements, A. J. O'Reilly, Pres., for paving several streets.

ST. JOSEPH, MO.—RACKLIFFE & GIBSON have been awarded the contract, at $1.75 per sq. yd., for paving Eighth St. with Hassem pavement.

BEAUMONT, TEX.—Bids are asked by the city until Sept. 1 for paving Hickory, Jefferson, College, Main and other streets. J. G. Sutton is City Secy.

LAWTON, OKLA.—The city has awarded the contract to CHARLES H. SHAW, Muskogee, Okla., for 45 blocks of street paving.

OLYMPIA, WASH.—The contract for paving on Fourth and Columbia Sts., bids opened on Aug. 3, has been awarded to the LISTER CONSTRUCTION CO., of Tacoma, Wash., at $3.56 per sq. yd. for vitrified brick and $3.66 per sq. yd. for creosoted wooden blocks, the work including about 7,500 sq. yds. of pavement. Millard Lemon is City Engr.

SEATTLE, WASH.—R. H. Thomson, City Engr., has reported the estimated cost of the following improvements: Occidental Ave., and other streets, filling, $12,500; alley in Block 12, Capitol Hill addition, paving, $3,300; 14th Ave. West and other streets, concrete walks, $8,342.

Contracts have been awarded for the construction of concrete sidewalks on Bayview St., and other streets, to the COAST CONCRETE CO., at $33,620. R. H. Thomson is City Engr.

PASADENA, CAL.—The contract for paving Los Robles Ave. with asphalt macadam was awarded by the City Council on Aug. 5 to the FAIRCHILD-GILMORE-WILTON CO., at $67,410; 13.8 cts. per sq. ft. for the pavement and 27 cts. a lin. ft. for the curbing.

LEWISTON, IDAHO.—The City Council has authorized the City Engineer to prepare specifications for bids for the various kinds of hard surface pavements.

MANUFACTURING PLANTS.

(denotes that this work is advertised in Engineering News.)*

ATTLEBORO, MASS.—Albert S. Ingraham has let general contract for his factory on Dunham and Union Sts., Attleboro, to E. K. WATSON, of Warren, R. I. The factory will be of brick. Work will be begun as soon as possible.

BRIDGEWATER, MASS.—J. H. Ball has purchased a lot on Hale and Depot Sts., and is reported to be planning to erect a factory thereon for manufacturing electrical supplies.

FALL RIVER, MASS.—The Directors of the Seaconnet Mills, Fall River, have voted to add about 10,000 frame spindles and the corresponding amount of looms and other machinery to their plant. The present mill be extended on the side next to the railroad tracks, on land owned by the corporation, and sufficient power to operate the additional machinery can be obtained from the present engine. The estimated cost of the addition and machinery is about $100,000. No change in the capital of the corporation is contemplated. The plans, which are being drawn by William T. Henry, are not completed.

HOLYOKE, MASS.—The Farr Alpaca Co. may erect a building this fall. The company states that it will put a dye house on the property, but the plans have not been drawn as yet. At present grading is being done on the land.

BROCKTON, MASS.—The plant of the Hideite Leather Co., Ames Sts., which was burned, will be rebuilt. The building will be 100 × 125 ft. in size and two stories high, with an addition two stories high and 60 × 9 ft. in size.

HARTFORD, CONN.—The Terry Steam Turbine Co., 233 State St., Hartford, is having plans drawn for a factory building on Windsor St. extension. The structure will be of brick, one story high, and 80 × 200 ft. A power plant will be erected.

WATERBURY, CONN.—The Waterbury Mfg. Co., 568 North Main St., Waterbury, Conn., has taken out a permit to build a structure at its plant at the North End. The plans are by T. B. Peck, Arch., 65 Bank St., and call for a brick building, seven stories high, mill construction, 162 × 50 ft., with a wing, seven stories, 50 × 50 ft. The roofing will be of gravel.

Plans have been prepared by Griggs & Hunt, Archs., 51 Leavenworth St., Waterbury, for a 4-story brick building, 42 ×150 ft., for the Steel & Johnson Mfg. Co., 779 South Main St.

BINGHAMTON, N. Y.—The Dun-McCarthy Co., shoe manufacturers, have let contract for their proposed factory, which is to be of brick, 46 × 202 ft., four stories in height, to the A. E. STEVENS CO. T. I. Lacey & Son, 1110 Kilmer Bldg., are the Archs.

SCHENECTADY, N. Y.—A factory building two stories in height will be erected by the W. W. Dutton Co., manufacturers of marble and granite monuments, at the corner of State and Martin Sts. The building will contain cutting and polishing rooms and blacksmith shop besides office and drafting rooms.

CANAJOHARIE, N. Y.—The Beech Nut Packing Co. is to erect an addition to its packing plant, to be 42 × 80 ft. and four stories in height.

NEW YORK, N. Y.—We are officially advised that Louis Giller, Arch., 416 Broadway, has let general contract to J. C. GABLER CO., 339 West 18th St., for a 4-story light manufacturing building for the Stephen W. Roach estate. Cost, $15,000.

William Higginson, Arch., Park Row Bldg., New York, advises us that he will prepare plans for a 3-story factory building for the C. S. Buell Co., 26 Court St., Brooklyn, manufacturers of roofing and skylights. The plans will be ready for estimates about Sept. 15 and will call for a building about 70 × 85 ft.

PATERSON, N. J.—We are officially advised that contract has been let by H. E. Danners, manufacturer of textiles, [illegible]4 Leonard St., New York, to FRANK B. GILBRETH, 34 West 26th St., New York, for construction of a brick and mill construction cotton mill, to be built at Fourth Ave. and River St., Paterson. Estimated cost $[illegible]0,000. F. W. Dean, 53 State St., Boston, Mass., is Engr.

ECONOMY, PA.—We have been officially informed that the National M[illegible] Molding Co. has decided to enlarge its factory at Economy, Pa. Contract for the structural steel work has been awarded to WILLIAM B. SCAIFE & SONS CO., 2[illegible] First Ave., Pittsburg, Pa.

WILKES-BARRE, PA.—The [illegible] Tobacco Co. will erect a 4-story brick factory on South Pennsylvania Ave. R[illegible] Uhl is Mgr.

HARRISBURG, PA.—It is the intention of the United American Iron & Steel Co., Trivoli, Albany, N. Y., to erect a plant here. D. H. Friedman is Pres.; William E. Friedman is Secy.

PHILADELPHIA, PA.—C. [illegible] Comstock, Arch., East End Hotel, Pittsburg, has prepared plans for a 1-story addition to the oil refining plant for D. B. Martin Co., Land Title Bldg., Philadelphia. Cost $25,000.

PUNXSUTAWNEY, PA.—The management of the Clark Steel Hoop Mill has selected a site here for the proposed plant. The main building will be 50 × 75 ft., and the shed will be 50 × 90 ft., and there will be an engine and boiler house, office, stock room and blacksmith shop. It is expected to have the mill in operation within two months.

WILMINGTON, DEL.—It has been announced that the Harlan & Hollingsworth Corporation, in this city, and the Bethlehem Steel Co. had been consolidated for the purpose of building in Wilmington a plant for the manufacture of steel passenger coaches and all kinds of steel freight cars. The name of the new company has not been determined. The Harlan plant here will be rebuilt and enlarged. Work on the plant will begin at once. The Bethlehem Steel Co. will make the steel and the cars will be erected in the local plant.

BALTIMORE, MD.—The Standard Overall Co., 143 West Pratt St., will erect an overall factory at Pratt and Penn Sts. The building will be five stories, 39 × 130 ft. Contract has been awarded to R. B. MASON, 324 West Biddle St., Baltimore.

WESTON, W. VA.—The Bastow Mfg. Co., of Pittsburg, Pa., has completed arrangements for the erection of a glass plant at Weston, which will employ about 200 people.

CHARLOTTE, N. C.—See under Light and Power Plants.

JACKSONVILLE, FLA.—Albert Kahn, it is stated, has been engaged to prepare plans for a motor factory to be erected for the Ford Motor Co. The plant is to consist of a main building having 258,000 sq. ft., four stories high, of reinforced concrete and steel, an office building, power-house and a group of sawtooth roof constructed buildings.

SPRINGFIELD, OHIO.—The Victor Rubber Co. has awarded to CHRISTOPHER WISE the contract for erection of its new factory, which will be located at the junction of the Erie and the Detroit, Toledo & Ironton and the Springfield, Troy & Piqua Railroads. The building will be of concrete and will be fireproof. H. H. Durr is Pres.

COLUMBUS, OHIO.—Contracts for constructing a cold storage plant at the Columbus State Hospital to cost $25,000, have been awarded as follows: building, to AUGUST ROEHR, of Bucyrus; machinery, to FRICK BROS., of Pittsburg, Pa., and insulation, to the CINCINNATI BUTCHERS' SUPPLY CO., Cincinnati.

CLEVELAND, OHIO.—The Otis Steel Co. will erect a plate mill to cost $600,000 at its plant, Lakeside Ave. and East 31st St. Geo. Bartol is Gen. Mgr.

DAYTON, OHIO.—A 4-story factory building will be erected on Geyer St., between Plant and Helena Sts., for the Dayton Folding Tonneau Co.

HUNTINGTON, IND.—W. T. Briant has ordered plans and will ask for bids soon for the construction of a bending factory.

WHITEHALL, MICH.—BUCK & MULLEN, of Muskegon, Mich., have been awarded the contract for the erection of a 5-story brick building, 60 × 245 ft., for the Eagle Tanning Works, at Whitehall.

DETROIT, MICH.—Louis Kamper, Arch., Fine Arts Bldg., Detroit, has let general contract to JOHN FINN & CO., for a 1-story laundry and 1-story power-house for the House of Providence.

The Detroit Edison Co., Alexander Dow, Gen. Mgr., is planning to duplicate its present plant. Estimated cost, $2,000,000.

FREEPORT, ILL.—J. E. O. Pridmore, Arch., First National Bank Bldg., Chicago, has made plans for a 6-story factory building for the Rawleigh Medical Co., Freeport. Cost, $50,000.

PONTIAC, ILL.—The following contracts have been let for the erection of an addition to the Pontiac Shoe Mfg. Co.'s factory: General and carpenter work, J. H. MICHEL; masonry, HENRY DAVIES; plumbing, G. H. MILLER. R. A. YOUNG, Sterry Block, Pontiac, is Arch.

CHICAGO, ILL.—Hill & Woltersdorf, Archs., 70 La Salle St., have awarded general contract to JAMES SHEDDEN & CO., 92 La Salle St., for a 2-story laboratory building for Thomas J. Dee & Co.

The Charles Garben Baking Co. has had

plans prepared by Paul Gerhardt, 109 Rand St., for [illegible]-story building to cost $50,000.

C. O. [illegible]sen, Arch., 242 Dearborn Ave., awarded carpentry to CHARLES NELSON for a manufacturing plant for Louis Hanson. Cost, $[illegible]0,000.

KASOTA, MINN.—We are officially advised that the Hubbard & Palmer Co., of Mankato, Minn., has awarded contract to the MINNEAPOLIS STEEL & MACHINERY CO., [illegible] Minnehaha Ave., Minneapolis, for a 10 x [illegible] Twin City Corliss engine, 60-in. x 16-ft. horizontal return tubular boiler, feed water heater and purifier, boiler feed pump, etc., for the new cleaning house and elevator at Kasota, Minn.

BONNER SPRINGS, KAN.—The directors of the Bonner Portland Cement Co. have voted to enlarge the company's plant, which is located about one mile east of the town. The enlarged mill will have a capacity of from [illegible] to 1,800 bbls. daily. W. H. Caffery is Pres.

GRAHAM, MO.—Bids are asked until Sept. [illegible] by the Moore Bros. Lightning Rod Co. for constructing a 2-story factory building, 44 x [illegible]0 ft. The structure will be built of brick and stone. I. W. Bond is Arch.

FORT BAYARD, N. MEX.—Bids are asked by Capt. S. P. Vestal, Constr. Q. M., until 11 a. m., Sept. 12, for constructing, plumbing, wiring and installing machinery in a steam laundry at this post.

TACOMA, WASH.—It is stated that the Chicago, Milwaukee & St. Paul Ry. Co. will erect car shops here. A. E. Manchester, St. Paul, Minn., is Supt. of Motive Power.

The Folger Heat & Reduction Co., which is capitalized at $2,500,000, intends to build a plant for the manufacture of its furnaces in Tacoma.

PORTLAND, ORE.—The Portland Railway, Light & Power Co. is proceeding with plans for the construction of a car barn at the Gold Links, with a capacity for 250 cars. F. I. Fuller is Gen. Mgr. Rys.

RIVERSIDE, CAL.—Work will be started at once by the Pacific Malleable Castings Co. on the construction of a foundry which is to be located at intersection of Jurupa Ave. and the Salt Lake Ry. William Kerr is Mgr. The foundry will cost $25,000. Oil will be used in the annealing and melting furnaces and electricity will be used as power for operating the factory.

FORT FRANCES, ONT.—The Ogilvie Flour Mills Co., Youville Pl., Montreal, Que., contemplates erecting a flour mill here with a capacity of 20,000 bbls. a day.

NEW WESTMINSTER, B. C.—The Sumas Dyking Co., Nem Westminster, B. C., will improve its plant at a cost of about $1,000,000.

VANCOUVER, B. C.—Wright & MacDonald have completed plans for a bakery to cost about $30,000, and stables to cost $5,000 for Hanbury, Evans & Co. Bids will be called for shortly. The bakery will include eight ovens at $800 each.

The Brooks-Scanlon Lumber Co., Lumber Exchange, Minneapolis, Minn., is considering the erection of a lumber mill near Vancouver, B. C., at a cost of about $300,000.

CONTRACT PRICES.

*FIRE MAIN SYSTEM.—Philadelphia, Pa.—Bids were received on July 29 by George R. Stearns, Dir. Pub. Wks., for Contract No. 140, extension of fire main system. Contract was awarded to MICHAEL O'ROURKE, 3330 G St., Philadelphia, at $148,310. (List of bids received was given under Water-Works on Aug. 13.) Mr. O'Rourke's bid in detail was as follows: 850 tons 8-in. flanged c.-i. pipe—for furnishing, $36 per ton; for laying, $3 per ton. 325 tons 12-in. flanged c.-i. pipe—furnishing, $36; laying, $4. 35 tons 8-in. and 12-in. special straight pipe under 8 ft.—furnishing, $95. Laying 115 tons c.-i. and steel specials, $6 per ton. Furnishing 60 tons 8-in. and 12-in. flanged curved pipe, $95. Furnishing 5 tons 8-in. and 12-in. c.-i. sleeves, $95. Furnishing 15 tons 8-in. and 12-in. steel flanged tees and crosses, $240. 92 fire hydrants in place, $110 each, complete. 158 8-in. stop valves, in place, complete, $70. Nine 12-in. stop valves, in place, complete, $115. 55,000 lbs. grey iron castings, in place, 6 cts. a lb. 1,000 lbs. steel "I" beams, 4-in. to 12-in., 6 cts. 12 1½-in. brass air valves, in place, $15. 17,000 cu. yds. earth excavation, not over 8 ft. below street surface, 60 cts. 5,000 cu. yds. earth excavation, over 8 ft. below surface, $1. 500 cu. yds. Portland cement, $8. 50 cu. yds. rubble masonry, $8. 250 cu. yds. brick masonry, $9. 4,000 lbs. steel and w.-i. fixtures, 6 cts. 3,000 lin. ft. t.-c. pipe lines, 15-in. and less, $1. 5,000 ft. B. M. hemlock timber, $40 per M. 5,000 ft. B. M. yellow pine timber, $45 per M. 5,000 sq. yds. repaving, sheet or block asphalt, $1.50. 28,000 sq. yds. repaving, granite blocks, 70 cts. 5,000 sq. yds. repaving, brick or artificial stone pavements or flagging, $1. 5,000 lin. ft. resetting curb, $1. Time limit, 140 days. Total, $148,310.

MISCELLANEOUS CONTRACTS.

U. S. RECLAMATION SERVICE.—Items regarding irrigation, canal projects, etc., will be found under Water-Supply—Irrigation.

ENGINEERING SUPPLIES.—New York, N. Y.—Bids are asked by the Board of Water Supply until 11 a. m., Aug. 25, for furnishing and delivering engineering supplies.

TIMBER.—New York, N. Y.—Bids are asked by the Department of Parks until 3 p. m., Aug. 27, for furnishing and delivering timber (No. 2, 1908) for parks, Boro. of the Bronx.

BREAKWATERS.—Cobourg, Ont.—She contract for the construction of two breakwaters in Cobourg Harbor has been awarded to the RANDOLPH MACDONALD CO., Toronto, at $140,000.

DITCH.—Redwood, Minn.—Bids are asked until Aug. 29, by L. P. Larson, County Auditor, for the construction of a ditch in Redwood and Brown Counties. Estimated cost, $26,000.

TELEPHONE SYSTEM.—Baldur, Man.—Bids are asked by John Harrower, Secy.-Treas. Rural Municipality of Argyle, until Aug. 21, for the construction of a telephone system.

*CEMENT.—Vicksburg, Miss.—Bids are asked until noon, Sept. 8, by Capt. Clarke S. Smith, Corps Engrs., U. S. A., Vicksburg, for furnishing Portland cement for use in construction of Lock and Dam No. 8, Ouachita River, Ark.

*CABLE.—Washington, D. C.—Bids are asked until noon, Aug. 28, by the Commissioners of the District of Columbia for furnishing underground signal and telephone cable for the Electrical Department of the District of Columbia.

*TRAVELING CRANE.—Dallas, Tex.—Bids are asked until noon, Aug. 24, by J. B. Winslett, for furnishing to the City of Dallas one 10-ton hand power traveling crane for the new pumping station at Turtle Creek, to be delivered f. o. b. Dallas.

*DREDGING.—New York, N. Y.—Bids are asked until noon, Sept. 14, by Col. John G. D. Knight, Corps Engrs., U. S. A., Army Bldg., New York, for dredging in Patchogue River, Great South Bay, N. Y., and Browns Creek, N. Y.

SWIMMING POOL.—New Haven, Conn.—Contract has been let to SPERRY & TREAT, 39 Church St., New York, for swimming pool at Yale University. Howells & Stokes, 100 William St., New York, are Archs. Estimated cost, $40,000.

DRAINAGE.—Piggott, Ark.—Bids are asked until Aug. 20 for constructing drainage District No. 5, including main ditch, laterals and sub-laterals. Estimated quantity, 250,000 cu. yds.; probable cost, $30,000. J. D. Mitchell, Engr., Greenway, Ark.

DEEPENING RIVER.—North Easthope, Ont.—The contract for straightening and deepening the River Avon has been let to AUGUST GUHR, of Gad's Hill, Ont., at $12,600. Work is to commence before Sept. 1, 1908, and finish by Dec., 1909.

*DRAINAGE.—Annawan, Ill.—Bids are asked by the Commissioners of the Mud Creek Special Drainage District, Henry County, until 10 a. m., Sept. 5, for the renewal of approximately 474,828 cu. yds. of material for construction of ditches in this district. H. E. Reeves, Atkinson, Ill., is Engr.

RETAINING WALL.—Brooklyn, N. Y.—Bids are asked by the Department of Parks, Boro. Manhattan, until 3 p. m., Aug. 27 for furnishing all the labor and materials necessary to underpin a masonry retaining wall at Highland Boulevard and New Jersey Ave., Boro. of Brooklyn, together with all incidental work.

LEVEE.—Alexandria, La.—Bids are asked by the Red River, Atchafalaya and Bayou Boeuf Levee Board until Aug. 25 for raising and enlarging levees in Avoyelles Parish, from Egg Bend to Choctaw bayou, and from Choctaw bayou to Moncla, work comprising about 275,000 cu. yds. The Board will enlarge Alexandria levee from Bayou Rapides dyke to lowest limits of city at estimated cost of $50,000, bids for which will be opened later; will also enlarge levees along Atchafalaya River in St. Landry Parish.

STADIUM.—San Francisco, Cal.—The Park Commissioners have appropriated $5,000 for the immediate construction of a section of the proposed grand-stand at the stadium to be erected in Golden Gate Park and which when completed will entirely circle the athletic amphitheater and provide seats for 150,000 spectators. The plans were drawn by Reid Bros., Claus Spreckels Bldg., San Francisco, the services being offered gratuitously. The work of construction will be directed by John C. Kirkpatrick, Park Comr.

ORE DOCKS, FURNACES.—Toledo, Ohio.—Announcement is made that Corrigan McKinney & Co. will build two new iron furnaces and extensive ore docks along the upper river that will cost approximately $2,500,000. Plans have been completed and ground operations will be started at once. The new furnaces will each have a capacity of 200,000 tons of pig iron yearly and will give employment to 800 men. The improvement is one of the most important steps in this district for years.

*RAILWAY WORK.—Philadelphia, Pa.—Bids are asked until noon, Sept. 16, by W. Hunter, Ch. Engr., 520 Reading Terminal, Philadelphia, for the following work: Contract No. 21—locomotive coaling station, Green St. Yard. Contract No. 31—coal pocket yard at northeast corner of Tenth and Norris Sts. Contract So. 32—masonry, embankment, paving, water and drainage systems and new freight office building in yard between Berks and Morris Sts., west side. Contract No. 35—drainage for yards between York St. and Cumberland St.

*DREDGING.—Trenton, N. J.—Bids were received as follows by Harry Schneider, Comr. Inland Waterways, Trenton, on Aug. 11, for dredging a section of the proposed inland waterway from Cape May to Bay Head, N. J., near the latter place: Hill Dredging Co. Atlantic City, 15 cts. per cu. yd.; Atlantic Dredging Co., Philadelphia, 16½ cts.; Rickards Dredging Co., Philadelphia, 24 cts.; Miner Engineering Co., Washington, D. C., 24 cts.; D. S. Voder, Atlantic City, 99 cts.; Richard Lamb 136 Liberty St., New York, 14½ cts.; International Construction Co., New York, 36 cts. The appropriation available this year for this work is $75,000.

*BARGE CANAL.—Albany, N. Y.—Bids are asked by F. C. Stevens, Supt. Public Works, until noon, Sept. 9, for Contract No. 20, Erie Canal, Sections 2, 3 and 4, for dredging a channel in the Mohawk River and performing work incidental thereto between Rexford Flats and Little Falls. Length, 58.7 miles. Engineer's estimate, $4,173,900. And for Contract No. 66, Erie Canal, Section 10, for the improvement of the Erie Canal from the west end of Contract No. 64 to about 600 ft. east of the Lockport Locks. Length, 6.35 miles. Estimated cost, $751,000.

Barge Canal Contract No. 31, for the improvement of the Erie Canal at Little Falls, has been awarded by F. C. Stevens, Supt. Public Works, to CASEY & MURRAY, of 311 Powers Bldg., Rochester, N. Y., for $829,770. Itemized bids are given this week under Contract Prices.

LEVEE.—New Orleans, La.—Bids are asked until 1 p. m. Aug. 20, by the Board of Commissioners, Fifth Louisiana Leve District, Tallulah, La., at office of Board of State Engineers, Room 402 Cotton Exchange Bldg., New Orleans, La., for construction of following levee work: Wilson's Point Levee, East Carroll Parish—Enlargement: contents, 50,000 cu. yds.; deposit, $200. Cottonwood Levee, East Carroll Parish—Enlargement; contents, 23,000 cu. yds.; deposit, $130. Point Lookout Levee, East Carroll Parish—Enlargement and new levee; contents, 115,000 cu. yds.; deposit required, $360; bond required, $5,700. Christmas Levee, Madison Parish—Enlargement; contents, 100,000 cu. yds.; deposit, $325. Diamond Island Levee Topping, Madison Parish—Contents, 55,000 cu. yds.; deposit, $210; bond required, $2,700. Rifle Point Levee, Concordia Parish—Enlargement; contents, 120,000 cu. yds.; deposit required, $375. Minorca to Palo Alto Levee, Parish of Concordia—Enlargement; approximate contents, 110,000 cu. yds.; deposit required, $350; bond required, $5,500. J. T. McClellan, Pres.

LEVEE.—New Orleans, La.—Bids are asked by Board of Commissioners, Orleans Levee District, Room No. 15, Masonic Temple, New Orleans, until Aug. 20 for construction of following work: Third District—Levee and revetment, from Louisa to Desire St.; length about 650 ft.; contents, about 45,000 cu. yds. of earth and about 36,000 ft. B. M. creosoted lumber; bond, $10,000; deposit, $500. Levee and revetment, from Mazant to Poland St.; length, about 1,000 ft.; contents, about 70,000 cu. yds. of earth and about 55,000 ft. B. M. creosoted lumber; bond, $15,000; deposit, $750. Fourth District—Levee, from Jackson Ave. to Third St.; length, about 1,700 ft.; contents, about 30,000 cu. yds. of earth; bond, $7,500; deposit, $400. Levee, from Seventh St. to Louisiana Ave.; length, about 2,100 ft.; contents, about 100,000 cu. yds. of earth; bond, $20,000; deposit, $1,000. Jules C. Koenig, Pres.; Peter E. Muntz, Secy.

U. S. POSSESSIONS AND CUBA.

LOCOMOTIVES.—Panama.—Bids were received as follows on Aug. 13, at the office of the Isthmian Canal Commission, Washington, D. C., for furnishing ten 40-ton locomotives, of the six-wheel switcher type, without tender, saddle tank, narrow-gage: American Locomotive Co., 30 Church St., New York, $62,000, $62,500, 75 days; Lima Locomotive & Machine Co., Lima, Ohio, $67,500, 112 days; alternative bid, $87,750, 82 days; H. K. Porter Co., Pittsburg, $59,450, 64 to 77 days; Vulcan Iron Works, Wilkes-Barre, Pa., $67,000, 126 days; Baldwin Locomotive Works, Philadelphia, $59,650, 60 to 70 days; Davenport Locomotive Works, Davenport, Iowa $79,350, 120 days.

DUMP CARS.—Panama.—Bids were received as follows on Aug. 13, at the office of the Isthmian Canal Commission, Washington, D. C., for furnishing 50 six-yard all-metal double dump cars: Atlas Car & Mfg. Co., Cleveland, Ohio, $42,500, 120 days;

CONTRACT PRICES.

BARGE CANAL.—Albany, N. Y.—Itemized prices of the bids received on Aug. 11 by F. C. Stevens, Supt. Public Works, for Barge Canal Contract No. 31 were as follows: Contract is for improving the Erie canal at Little Falls and modifying dam and constructing guard gates at Rocky Rift; length, 1.01 miles. The bids were: (A) Engineer's estimate ($813,800); (B) Fidelity Construction Co., Majestic Bldg., Detroit, Mich. ($837,988); (C) William Engineering & Contracting Co., 13 Park Row, New York ($850,594); (D) Casey & Murray, Powers Block, Rochester, N. Y. ($829,770); (E) Coast and Interior Contracting Co., Fayetteville, N. Y. ($881,318); (F) The John Pierce Co., 90 West St., New York ($864,655):

	(A)	(B)	(C)	(D)	(E)	(F)
Clearing, lump sum	$100.00	$100.00	$100.00	$100.00	$100.00	$100.00
244,000 cu. yds. excavation	1.20	1.20	1.44	1.25	1.44	1.35
250 cu. yds. removal of dam masonry	3.50	3.50	4.00	3.50	3.50	3.50
1,000 lin. ft. round bracing	.15	.15	.15	.15	.15	.15
30 M. ft. B. M. sheeting and bracing, per M.	50.00	50.00	50.00	50.00	50.00	50.00
43,000 sq. ft. channeling	.18	.18	.20	.21½	.20	.18
15,800 cu. yds. embankment	.12	.12	.12	.14	.14	.12
3,320 cu. yds. lining	1.25	1.45	1.25	1.40	1.25	1.25
740 cu. yds. puddle	2.00	2.00	2.40	2.35	2.00	2.00
76 M. ft. B. M. sawed lumber, per M.	55.00	55.00	60.00	55.00	55.00	55.00
4.5 M. ft. B. M. white oak lumber in miter sills and gates, per M.	100.00	100.00	100.00	115.00	100.00	100.00
7 M. ft. B. M. sawed lumber in needles, per M.	75.00	75.00	75.00	75.00	75.00	75.00
5,300 lin. ft. round timber	.20	.20	.20	.20	.20	.20
57,200 cu. yds. second-class concrete	6.00	6.25	5.75	5.90	6.00	6.25
380 cu. yds. reinforced concrete	10.00	10.00	10.00	12.00	12.00	10.00
3 cu. yds. first-class masonry coping	30.00	30.00	36.00	30.00	36.00	30.00
9,240 cu. yds. dry retaining wall, including coping	1.75	2.00	1.75	2.10	2.10	1.75
168 sq. yds. third-class stone paving	2.25	2.25	2.25	2.70	2.25	2.25
180 sq. yds. cobblestone paving	1.00	1.00	1.00	1.00	1.00	1.00
230 cu. yds. first-class riprap	3.00	3.00	3.00	3.00	3.00	3.00
12,400 cu. yds. fourth-class riprap	1.50	1.70	1.50	1.50	1.80	1.50
155,200 lbs. structural steel	.05	.05	.05	.05	.05	.05
110,300 lbs. metal reinforcement	.04	.04	.04	.04	.04	.04
26,800 lbs. iron castings, plain	.03⅓	.04	.03½	.03⅓	.03½	.03⅓
13,000 lbs. iron castings, machined	.06	.06	.06	.06	.06	.06
138,000 lbs. metal in upper lock gates	.06	.06	.06	.06	.06	.06
430,000 lbs. metal in lower lock gates	.06	.06	.05	.06	.06	.06
80,000 lbs. metal in buffer beams	.06	.06	.06	.06	.06	.06
60,000 lbs. metal in lock valves	.10	.11½	.10	.10	.10	.10
680,000 lbs. metal in guard gates	.06	.06½	.05	.06	.06	.06
1,500 lin. ft. wooden fence	.20	.20	.20	.24	.20	.20
1,080 lin. ft. wrought-iron pipe railing	1.00	1.00	1.00	1.00	1.00	1.00
184 lin. ft. lattice railing	1.50	1.50	1.50	1.50	1.50	1.50
2,500 lin. ft. filling seams	.20	.20	.20	.24	.22	.20
3,000 lin. ft. repointing old masonry	.05	.05	.05	.05	.05	.05
2 storehouses, each	800.00	800.00	800.00	950.00	800.00	800.00
Cofferdams, pumping, bailing and draining, lump sum	10,000.00	10,000.00	12,000.00	12,000.00	10,000.00	10,000.00
600 lin. ft. drilling bolt holes in rock	.60	.60	.60	.70	.60	.60
For raising bridge superstructure, lump sum	1,500.00	1,500.00	1,500.00	1,800.00	1,500.00	1,500.00
For maintaining highway traffic, lump sum	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00
For maintaining navigation, lump sum	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00
Deduct price to be paid to the State of New York for buildings in place which are to be removed by the contractor without expense to the State, lump sum	3,500.00	3,500.00	3,500.00	3,500.00	3,500.00	3,500.00
Deduct price to be paid to the State of New York for bridge superstructures in place which are to be removed by the contractor without expense to the State, lump sum	50.00	50.00	50.00	50.00	50.00	50.00
Totals	$813,800.00	$837,988.00	$850,594.33	$829,770.43	$881,318.00	$864,655.33

American Car & Foundry Co., 165 Broadway, New York, $25,900, 90 to 135 days; Fox Bros. & Co., 126 Lafayette St., New York, $24,950, 135 days; Arthur Koppel Co., 68 Broad St., New York, $30,000, no time stated; Manning, Maxwell & Moore, 85 Liberty St., New York, $23,384.50, 120 days; Motley, Green & Co., 66 Broad St., New York, $24,250, $25,500, 100 days; Vermilye & Power, 50 Church St., New York, $23,250, 120 days; Wonham-Magor Engineering Works, New York, $43,750, $38,000, 140 days; William J. Oliver Mfg. Co., Knoxville, Tenn., $29,750, 79 days; Western Wheeled Scraper Co., Aurora, Ill., erected, $34,500, $43,250; knocked down, $30,500 $38,500; Western draft rigging, $29,800, $37,800, 90 days.

CIVIL SERVICE EXAMINATIONS.

EXAMINER OF ACCOUNTS.—Washington, D. C.—The U. S. Civil Service Commission announces an examination on Sept. 3-4, to secure eligibles from which to make certifications for the appointment of examiners in the Division of Accounts, Interstate Commerce Commission. The salaries will range from $1,800 to $3,000 a year, and traveling expenses will be allowed when away from Washington or other official headquarters. It is expected that approximately 75 appointments will be made if sufficient high-grade eligibles result from this examination. The purpose of the examination is to establish registers of men with expert qualifications in the fields of railway or other common-carrier accounting. Age limit, 23 to 48 years. Application Form 304 and a copy of the Federal Act to Regulate Commerce. Applications must be filed prior to closing hour on Aug. 24.

INSPECTOR OF MECHANICAL AND ELECTRICAL ENGINEERING.—Washington, D. C.—An examination will be held by the U. S. Civil Service Commission on Sept. 2-3 to secure eligibles from which to make certification to fill a vacancy in the position of inspector of mechanical and electrical engineering (male), at $2,190 a year, in the office of the Supervising Architect, Treasury Dept., and vacancies as they may occur in any branch of the service requiring similar qualifications. Age limit, 20 years or over. Application Form 1312. Applications must be filed prior to closing hour, Aug. 22.

RODMAN, ASSISTANT IN LEGISLATION.—Albany, N. Y.—Examinations will be held by the State Civil Service Commission on Sept. 5 throughout New York State for the following positions: Rodman—$3.50 to $4 a day. Minimum age, 20 years. Subjects of examination and relative weights: Theoretical and practical questions, including mensuration and use of logarithms, plane trigonometry, elementary mechanics, surveying, leveling and mapping, theory and use of rod, level and transit, and highway construction.

Assistant in Legislation.—State Library.—$1,200 to $1,500. Open to men who are college graduates or have an equivalent education. One appointment is expected. The work consists in part of preparing the annual index of State legislation, digest of Governor's messages in all States and review of legislation, issued by the library and the collection and classification of material on legislative subjects. (Examination postponed from June 27.)

Intending competitors must execute application blanks and file them in the office of the Commission before noon, Aug. 29. Candidates having applications on file will be given ample notice of the time and place of examination. No one will be admitted to the examination without the official notice (Form E-8) from the Chief Examiner of the Commission. Age limit, 21 years or over.

CIVIL ENGINEER AND SUPERINTENDENT OF CONSTRUCTION.—New London, Conn.—The U. S. Civil Service Commission announces an examination on Sept. 9-10, to secure eligibles for which to make certification to fill a vacancy in the position of civil engineer and superintendent of construction, at $1,500 a year, in the Quartermaster's Department at Large, New London, Conn., and vacancies requiring similar qualifications as they may occur in any branch of the service. Age limit, 20 years or over. Application Form 1312. Applications must be filed prior to closing hour on Aug. 31.

TEACHER.—Philippines.—The U. S. Civil Service Commission announces an examination on Aug. 26-27, to fill a large number of vacancies in the positions of clerk and teacher in the Philippine Service. The entrance salary of the majority of male appointees will be $1,200 a year, although some appointments may be made at salaries of $1,000 or $1,100, based upon the experience and the relative standing in the examination, and they will be eligible for promotion up to $2,000 a year for teachers. Eligibility in the assistant examination is required for promotion to the positions of division superintendent, which carry salaries ranging from $1,600 to $3,000. The work of American men teachers is largely of a supervisory character, and the higher positions are filled as vacancies occur by the promotion of those who have demonstrated their efficiency and ability in the service. Men only will be admitted to the examination for assistant. Women will not be admitted to the teacher examination unless they are the wives, immediate relatives, or fiancees of men examined for teacher or assistant or appointed to or already employed in the Philippine service as teacher. Age limit, 18 to 40 years. Application Forms 2 and 375. Applications which are received too late for this examination will be kept on file for the next examination.

SCIENTIFIC ASSISTANTS.—Philippines.—The U. S. Civil Service Commission announces an examination on Sept. 2, to secure eligibles from which to make certification to fill four vacancies in the position of agricultural inspector at $1,200 a year, two vacancies in the position of assistant agricultural inspector at $1,000, and vacancies requiring similar qualifications as they may occur in the Philippine Service. Age limit, 18 to 40 years. Application Forms 2 and 375.

TRADE PUBLICATIONS.

CONCRETE REINFORCING.—Trussed Concrete Steel Co., Detroit, Mich. 8½ × 11 ins.; pp. 4; illustrated.

This company has put on the market a new form of reinforcing of the expanded metal variety known as Hy-Rib.

FLAKE GRAPHITE.—Joseph Dixon Crucible Co., Jersey City, N. J. Paper; 3½ × 6¼ ins.; illustrated.

This pamphlet describes the action of flake graphite as a lubricant and explains its superiority for various classes of lubrication.

ELECTRIC CAR LIGHTING.—Consolidated Railway Electric Lighting and Equipment Co., 11 Pine St., New York City. Bulletin 6. Paper; 6 × 9 ins.; pp. 6; illustrated.

The "Axle-Light" system is described in the most general way in these few pages.

POLYPHASE INDUCTION MOTORS.—Bulletin No. 105. Crocker-Wheeler Co., Ampere, N. J. Paper; 7½ × 10 ins.; pp. 11; illustrated.

The mechanical features, dimensions, applications, etc., of a line of 60 and 25-cycle induction motors, are set forth in this pamphlet.

FEED WATER HEATERS.—Harrison Safety Boiler Works, Philadelphia, Pa. Paper; 3½ × 6 ins.; pp. 12; illustrated.

The advantages gained by the use of Cochrane heaters are discussed with especial reference to their use in the boiler plants of collieries.

STEEL SHEET PILING.—The Canton Bridge Co., John Newell. Gen'l Agt., Albany, N. Y. 6 × 9½ ins.; pp. —; illustrated.

This catalogue describes a special kind of sheet piling with curved spring outstanding sections which clamp into each other to form watertight barriers.

For other Proposal Advertisements see pages 43, 44, 45, 46, 50, of Advertisements and Construction News page 72.

SANITARY SEWERS.

Ridgway, Pa.

Sealed proposals will be received by The Borough of Bidgway, addressed to G. F. Greiner, Secretary, until 12 o'clock noon, August 31st, 1908, for performing all the labor and furnishing all the material, exclusive of the terra cotta pipe, required in and about the construction of a system of sanitary sewers, whose lengths and sizes are approximately as follows:

3,300 feet of 15 inch.
4,920 feet of 8 inch.
4,830 feet of 6 inch.
28 manholes.

All bids must be upon blank forms and must be accompanied by a certified check for five hundred ($500) dollars, made payable to The Borough of Ridgway.

Specifications and blank forms of proposals may be obtained from the Borough Secretary and plans and profiles may be seen at the office of F. W. Ward, Borough Engineer.

The right is reserved to reject any or all bids.

G. F. GREINER,
Borough Secretary.

BRIDGE SUPERSTRUCTURE.

Russell, Mass.

Sealed bids for furnishing the Superstructure of a Bridge over the Westfield River will be received by the Bridge Committee, Russell, Massachusetts, at the Office of the Selectmen, of said town, until 2 o'clock p. m., of Tuesday, September 1st, 1908, and at that time will be publicly opened and read.

Bridge consists of two spans of about 122 feet in the clear; roadway, 20 feet wide; sidewalk, 5 feet wide.

Each bid must be accompanied by a properly certified check for eight hundred (800) dollars.

Plans can be seen and blank forms of proposals and contracts obtained at the Office of Oren E. Parks, Engineer, Westfield, Mass., on and after Monday, August 24th, 1908.

The Bridge Committee reserves the right to reject any and all bids should it deem it advisable to do so, and reserves the right to award the contract as it deems best.

H. C. PARSONS, Chairman;
E. D. PARKS, Secretary;
Bridge Committee.
August 20, 1908.

POWER PLANT EQUIPMENT.

THE SANITARY DISTRICT OF CHICAGO TO CONTRACTORS.

Sealed proposals for furnishing and installing alternating current generator, turbine water wheel unit, switchboards, transformers and wiring electrical apparatus, are invited by The Sanitary District of Chicago and will be received by the Clerk of said Sanitary District at Room 1500, American Trust Building, Chicago, Ill., until 12 M. (standard time) on Wednesday, Sept. 24, 1908, and will be publicly opened by the Board of Trustees at a meeting to be held on that day.

Proposals may be made upon any or all of the following Divisions:

Division A—Alternating Current Generator and Rheostat.

Division B—Switchboard Panels and Oil Circuit Breaker Switches.

Division C—Generator and Transformer Connections.

Division D—Transformers.

Division E—Turbine Water Wheel Unit.

All of the work above mentioned must be commenced within 20 days after the award of the contracts and must be entirely completed within 240 days after such award.

All proposals must be made upon blank forms, furnished by said Sanitary District and in accordance with the plans, specifications and contract form on file in the office of the Electrical Engineer of said Sanitary District at Room 1500, American Trust Building, Chicago, Ill. Said plans, specifications and form of contract, bond and proposal may be obtained upon application therefor.

All proposals must be delivered at the office of said Clerk of said Sanitary District in a sealed package, addressed to "The Board of Trustees of The Sanitary District of Chicago," and endorsed, "Proposals for alternating current generator, turbine water wheel unit, switchboards, transformers, or wiring."

The bids upon each and any of said Divisions shall be considered as separate and distinct from all others, and separate certified check or cash, equal to ten (10%) per cent. of the amount bid upon each Division, shall be deposited with the bids thereon and shall accompany the proposal. All certified checks must be drawn on some responsible bank, doing business in the City of Chicago, and shall be made payable to said, The Sanitary District of Chicago.

Said amounts deposited with bids will be held by said Sanitary District until all the respective bids for said work have been canvassed and the contracts awarded and signed. The return of said checks or cash to the bidder, to whom all or any part of said work shall be made, is conditioned upon the appearance of such bidder within ten (10) days, after receiving notice of such award, with bondsman, and executing a contract with said Sanitary District for the work so awarded, and giving a bond satisfactory to said Board of Trustees, for the faithful performance of such contract, for an amount equal to fifty (50%) per cent. of the contract price.

Said Board of Trustees reserves the right to reject any and all proposals.

THE SANITARY DISTRICT OF CHICAGO
By Robert R. McCormick,
President of its Board of Trustees.
Attest:
I. J. BRYAN, Clerk.
Chicago, Aug. 19, 1908.

MACADAM ROADS.

Decatur, Ala., August 15, 1908.

Sealed proposals for construction of a system of Macadam Roads in Morgan Co., Ala., will be received at office of undersigned until Monday, Sept. 14, 1908; $240,000 to be expended. Plans and specifications on file for first 30 miles after September 1st.

WM. E. SKEGGS,
Judge of Probate.

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., August 18, 1908.—Sealed proposals will be received at this office until 3 o'clock P. M. on the 1st day of October, 1908, and then opened, for alterations to the U. S. Post Office and Court House at Charlottesville, Virginia, in accordance with the drawings and specification, copies of which may be had at this office or at the office of the Postmaster at Charlottesville, Va., at the discretion of the Supervising Architect. JAMES KNOX TAYLOR, Supervising Architect.

DEPARTMENT OF PUB[illegible] WORKS.
Bureau of Wa[illegible]
Office, Room 790, [illegible] Hall,
Philadelphia, Augu[illegible] 1908.

Sealed proposals, endorsed [illegible] Bids for Apparatus for Cleaning Slow [illegible]d Filters," and addressed to the [illegible]rsigned, at the office above mentio[illegible] will be received until 12 o'clock noo[illegible] Thursday, Sept. 3, 1908, for

Contract No. 152—Apparat[illegible] Cleaning Slow Sand Filters for th[illegible]per and Lower Roxborough and Tor[illegible]le Filters.

Specifications and blank [illegible] upon which bids must be made [illegible] be obtained at the office of the C[illegible] of the Bureau of Water, Room 790-A, [illegible]y Hall, to whom all communications [illegible]uld be addressed.

No bid will be considered un[illegible] accompanied by a certificate from [illegible]e City Solicitor that the provisions [illegible]n ordinance requiring proposal bond[illegible]hen the bids exceed in amount five hu[illegible]d dollars, approved May 25, 1860 (p[illegible] West), have been complied with.

The Director reserves to h[illegible]elf the right to reject any or all b[illegible] as he may deem best for the intere[illegible] of the city.

GEORGE R. STE[illegible]NS,
[illegible]rector.

COMMONWEALTH OF MASSACHUSETTS, Metropolitan Water and Sewerage Board. Laying Water Pipe. Sealed proposals will be received at the office of the Metropolitan Water and Sewerage Board, 1 Ashburton Place, Boston, Mass., until 2.30 o'clock P. M. of Wednesday, September 2, 1908, for laying 12,400 linear feet of cast-iron water pipe in Boston and Brookline, Mass. Plans for the work can be seen and pamphlets containing further information for bidders, forms of proposal, contract and specifications can be obtained at the office of the Chief Engineer, 1 Ashburton Place. The printed forms must be used in making proposals. The Board reserves the right to reject any or all bids or to accept the proposal deemed best for the Commonwealth. HENRY H. SPRAGUE, Chairman; HENRY P. WALCOTT, JAMES A. BAILEY, JR., Metropolitan Water and Sewerage Board. DEXTER BRACKETT, Chief Engineer of Water-Works; WILLIAM N. DAVENPORT, Secretary. Boston, August 18, 1908.

Situations Wanted

STRUCTURAL DRAFTSMAN, also derrick experience; desires position. Address "S. 7," Engineering News, New York. 8-1t

ENGINEER, having had considerable marine experience, late chief engineer large ocean-going steamers. First-class certificated. British; experience in all systems of refrigeration. Dock yard, electric lighting, inspection of work and commercial experience. Desire position as assistant to consulting engineer, superintendent. Take charge of erection of machinery, contractors' plants, master mechanic, etc., or any position of trust. Address "P. A. 8," Engineering News, New York. 8-1t

Situations Open

WANTED—At once, resident engineer for sewer and water-works construction. Give detailed information about experience and salary expected. SOLOMON-NORCROSS CO., 1622 Candler Bldg., Atlanta, Ga. 8-1t

Miscellaneous Wants

WANTED

To purchase the whole or part interest in an

Engineering and Surveying Business

Give full particulars.

Address "X A 8," Engineering News, New York. 8-2t

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